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PRC

April 12, 1991

RECEIVED
APR 15 1991
WASTE MANAGEMENT BRANCH

Ms. Marcia Bailey
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101

RE: Contract No. 68-W9-0009, Work Assignment No. 112R10047, Quality Assurance Project Plan (QAPjP) for the Yakima Agricultural Research Laboratory site, Yakima, Washington

Dear Ms. Bailey:

PRC Environmental Management, Inc., (PRC) is pleased to submit two copies of the enclosed QAPjP for the Yakima Agricultural Research Laboratory site in Yakima, Washington. Sampling is scheduled for May 6 and 7, 1991. If you have any questions or comments, please contact Benjamin Farrell or me at (206) 624-2692.

Sincerely,

Gary A. Bruno

Gary A. Bruno
Environmental Geologist

Enclosures

cc: Laura Castrilli, EPA QAO, Seattle (without enclosure)

USEPA SF
1599695

contains recycled fiber and is recyclable

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YAKIMA AGRICULTURAL RESEARCH LABORATORY
YAKIMA, WASHINGTON

OPERATION AND MAINTENANCE INSPECTION

QUALITY ASSURANCE PROJECT PLAN

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 10
Seattle, Washington

Work Assignment No.	:	12R10047
EPA Region	:	10
EPA I.D. No.	:	WAD 120513957
Date Prepared	:	April 12, 1991
Contract No.	:	068-W9-0009
PRC No.	:	112-R10047
Prepared by	:	PRC Environmental Management, Inc.
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YAKIMA AGRICULTURAL RESEARCH LABORATORY
YAKIMA, WASHINGTON

OPERATION AND MAINTENANCE INSPECTION

Revision No. 0

April 11, 1991

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 10
Seattle, Washington

Prepared by

PRC Environmental Management, Inc.

Approvals:

Marcia Bailey **U.S. EPA Region 10 Work Assignment Manager**	**Date**
Barry Towns **U.S. EPA Region 10 Quality Assurance Officer**	**Date**
Carolyn Wilson **U.S. EPA Region 10 Sample Control Officer**	**Date**
James Pankanin **James Pankanin** **PRC Project Manager**	4/12/91 **Date**

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1.0 PROJECT DESCRIPTION

The U.S. Environmental Protection Agency (EPA) requested PRC Environmental Management, Inc. (PRC) to perform an operation and maintenance (O&M) inspection at the Yakima Agricultural Research Laboratory (YARL) site in Yakima, Washington under the Technical Enforcement Support (TES) 12 program.

This quality assurance project plan (QAPjP) was prepared to fulfill EPA quality assurance and quality control (QA/QC) requirements for receiving and analyzing split groundwater samples at the YARL site. This plan establishes data quality objectives and outlines QA/QC procedures for split sampling and analysis of groundwater from the YARL site for hazardous constituents.

1.1 SITE DESCRIPTION AND HISTORY

The YARL site is located at 3706 West Nob Hill Boulevard in Yakima, Washington (Figure 1-1). The 9.5-acre site is situated in a residential area within one-half mile of three schools, two hospitals, and three shopping centers.

The laboratory is administered by the U.S. Department of Agriculture. Originally an orchard, the YARL site was used for pesticide research beginning in 1961 (Tetra Tech, 1989). Several types of pesticide wastes and solvents were disposed of directly on the ground until 1965. Between 1965 and 1985, wastes were discharged to a septic tank and drainfield system at the facility. The system consisted of a 300-gallon concrete tank that drained a sink, a toilet, and an outside surface drain and wash pad. Tank effluent was discharged through a 30-foot drain tile placed approximately 2 feet below grade. Roughly 5,000 gallons of rinsate from pesticide application equipment and a maximum of 250 gallons of residual pesticide solutions were discharged through the system yearly (Biospherics, 1988). The presence of highly permeable sands and gravels raised concern that pesticides and solvents had leached into the uppermost, shallow, drinking-water aquifer (Tetra Tech, 1989).

YARL submitted a Resource Conservation and Recovery Act (RCRA) Part A permit application in September 1980 and received interim status. A preliminary assessment and site investigation pursuant to the Comprehensive Environmental Response, Conservation, and Liability Act (CERCLA) were conducted in June 1982. The site was proposed for the Superfund

National Priorities List in December 1982. YARL is currently ranked 949 among the 989 sites on the National Priorities List (55 Federal Register 22031, May 31, 1990).

A closure plan for the septic tank and drainfield system that includes a monitoring plan for sampling and analyzing groundwater and soil was submitted by YARL in January 1985. In March 1987 YARL submitted a revised version of this closure plan, which was approved by Washington Department of Ecology in May 1987. However, in September 1987, EPA determined that the closure plan did not meet the requirements of 40 CFR 265 Subpart G and requested that a revised closure plan be submitted to EPA after implementation of a groundwater monitoring system pursuant to 40 CFR 265 Subpart F. This groundwater monitoring system, consisting of four wells, was installed in April 1988. A revised closure plan was submitted and subsequently approved by EPA on January 30, 1990. As required by the approved closure plan, three additional wells were drilled and completed by July 1990.

Analytical data from the August 1990 quarterly groundwater sampling report show no volatile organic compounds (VOCs), pesticides, or herbicides at concentrations greater than quantification limits (Hong West and Associates, 1990b). Minor quantities of metals, including mercury, vanadium, and zinc, were detected below the maximum contaminant levels (MCLs) for drinking water established in 40 CFR 264.93 (Hong West and Associates, 1990b). However, analytical data collected from the monitoring wells during a September 1988 comprehensive groundwater monitoring evaluation show detectable concentrations of VOCs, including chloroform (1-12 μg/L), carbon tetrachloride (4-38 μg/L), and tetrachloroethane (1-3 μg/L), in some of the well samples (Tetra Tech, 1989). With the exception of carbon tetrachloride, the VOC concentrations do not exceed MCLs. However, both chloroform and tetrachloroethane are carcinogenic compounds. Arsenic also was detected in concentrations below the MCL, but above background during the comprehensive groundwater monitoring evaluation sampling event (Tetra Tech, 1989).

1.2 OBJECTIVES OF THE OPERATION AND MAINTENANCE INSPECTION

The O&M is based on the objectives established by EPA (1988d). Generally, the purpose of the inspection is to evaluate how the facility operates and maintains its groundwater monitoring system in terms of pertinent RCRA regulations, permit requirements, and other requirements to which it is subject.

The specific objectives of the YARL O&M inspection are to:

- Evaluate the compliance of the groundwater monitoring system with RCRA interim status groundwater monitoring regulations (40 CFR 265, Subpart F) and the EPA-approved closure plan dated September 12, 1989
- Evaluate the facility's sampling protocol and methods, including adherence to the approved or current sampling and analysis plan and completeness and technical adequacy of the plan
- Evaluate the adequacy of the analytical program and performance by receiving and analyzing split groundwater samples
- Evaluate the maintenance of the existing groundwater monitoring system by determining whether field sampling devices are in working order, whether the facility is abiding by maintenance provisions outlined in the sampling and analysis plan, and whether individual monitoring wells in the groundwater monitoring system yield representative groundwater samples

1.3 INSPECTION ACTIVITIES

The objectives and data needs described above will be met by observation of field sampling activities and analysis of split groundwater samples. PRC will evaluate whether sampling activities follow the requirements of 40 CFR 265 Subpart F, the EPA-approved closure plan, the sampling and analysis plan, and generally accepted groundwater sampling procedures specified by EPA (1986c). The following specific sampling activities will be monitored during the sampling event:

- Depth-to-water measurements
- Field measurements of water quality parameters (pH, specific conductance, and temperature)
- Well purging
- Sample collection
- Equipment decontamination
- Quality assurance procedures
- Chain-of-custody procedures

Any inconsistencies or deficiencies in the observed sampling procedures will be documented in the inspection report.

In addition to observing sampling activities, PRC will receive split groundwater samples from on-site monitoring wells. The split samples will be analyzed by the EPA Region 10 Manchester laboratory or a Contract Laboratory Program (CLP) laboratory, depending on availability, for site-specific constituents including VOCs, organo-chlorine pesticides, organo-phosphorous pesticides, chlorinated herbicides, and metals using the methods specified in this document. Analytical methods specified by EPA (1986a, 1987) (SW-846) are selected in order to replicate the analytical methods currently used by YARL.

1.4 SCHEDULE OF PROJECT ACTIVITIES

The anticipated project schedule follows:

Activity	Dates
Sampling and Analysis	
Field split sampling	May 6 and 7, 1991
Sample analysis (by EPA Region 10 Manchester laboratory or CLP laboratory)	Week of May 6, 1991
Deliverables	
QAPjP	April 15, 1991 (approval by EPA)
Health and safety plan	April 29, 1991 (approval by EPA)
Data validation report	30 days after receipt of CLP data (approximately July 1, 1991)
O&M inspection report	60 days after receipt of EPA, CLP, and facility data (approximately August 1, 1991)

1.5 DATA USAGE

The O&M inspection generates two types of data:

- Information on groundwater monitoring activities at the site
- Analytical data from split groundwater samples

The inspection information is used to evaluate the facility's operation and maintenance of its groundwater monitoring system. The split-sample analytical data is used to evaluate the adequacy and performance of the facility's analytical program.

1.6 SAMPLING RATIONALE

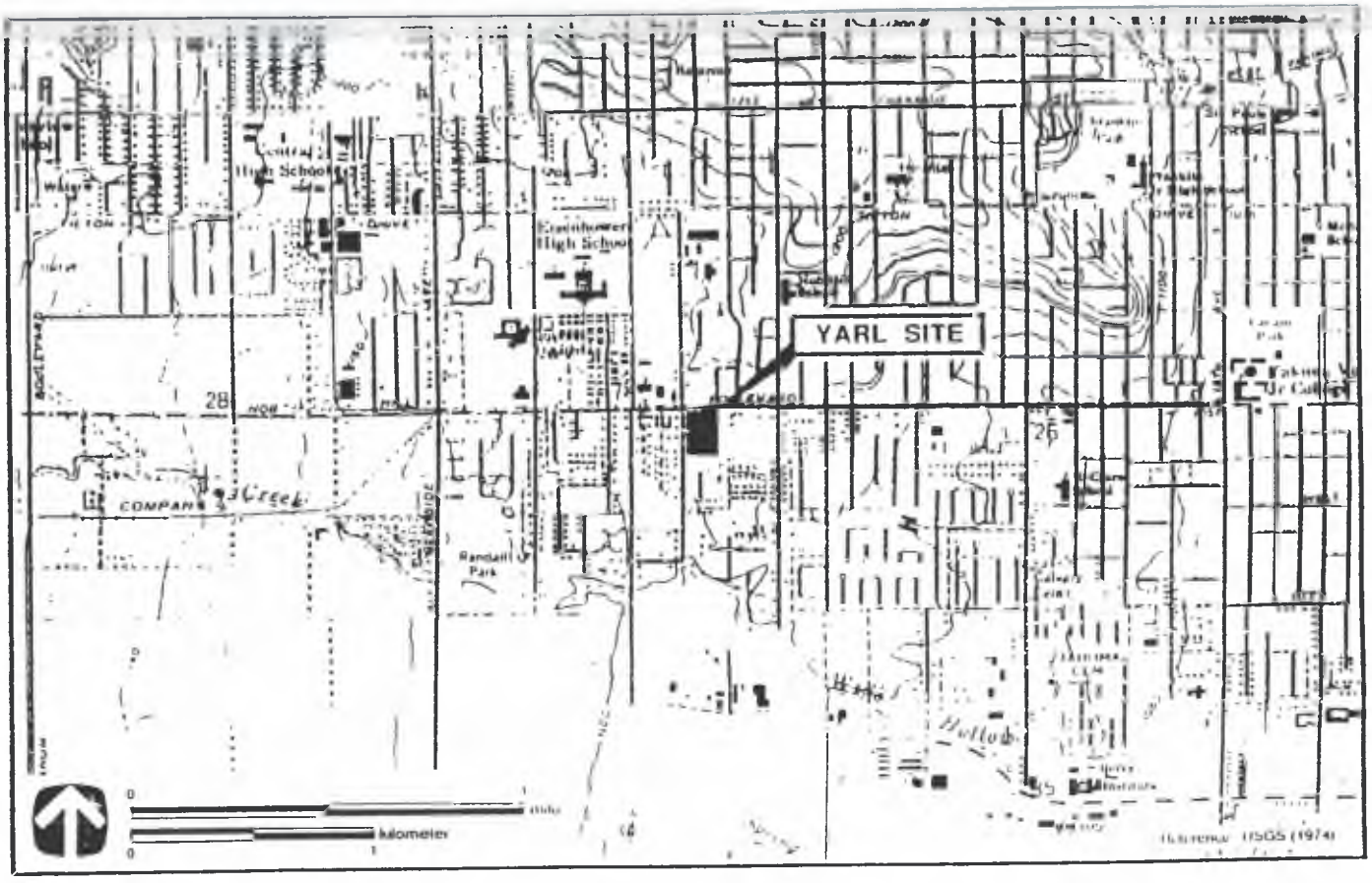
The groundwater monitoring system consists of seven monitoring wells (MW-A through MW-G) (Figure 1-2). Monitoring well D (MW-D) is located to the northwest of the septic tank and drainfield system, and the six other monitoring wells are located to the south-southwest of the septic tank and drainfield system.

The regional groundwater system consists of two aquifers. The upper, shallow aquifer consists of sands and gravels of the Ellensburg Formation. The lower aquifer is located in interflow zones of the underlying Columbia River basalts (Tetra Tech, 1989). All seven monitoring wells are screened in the upper aquifer (Hong West and Associates, 1990b). The direction of groundwater flow is generally to the south-southeast toward Wide Hollow Creek (Tetra Tech, 1989). The direction of groundwater flow may vary as much as 45 degrees (Tetra Tech, 1989). The effect of agricultural irrigation practices on the direction of groundwater flow is unknown. MW-D is located upgradient of the contaminants, while all other wells are potentially downgradient, depending on the direction of groundwater flow (Tetra Tech, 1989). MW-E was installed at a depth of 125 feet to generate information regarding vertical hydraulic and chemical gradients within the upper aquifer (Hong West and Associates, 1990b) All other wells are screened in the uppermost 10 feet of the aquifer, which has a depth-to-water of 32-34 feet (Tetra Tech, 1989).

Five of the seven monitoring wells are selected for split sampling in an effort to receive representative groundwater samples from upgradient and downgradient locations and from both new and older wells. The selected wells are listed and described in Table 1-1.

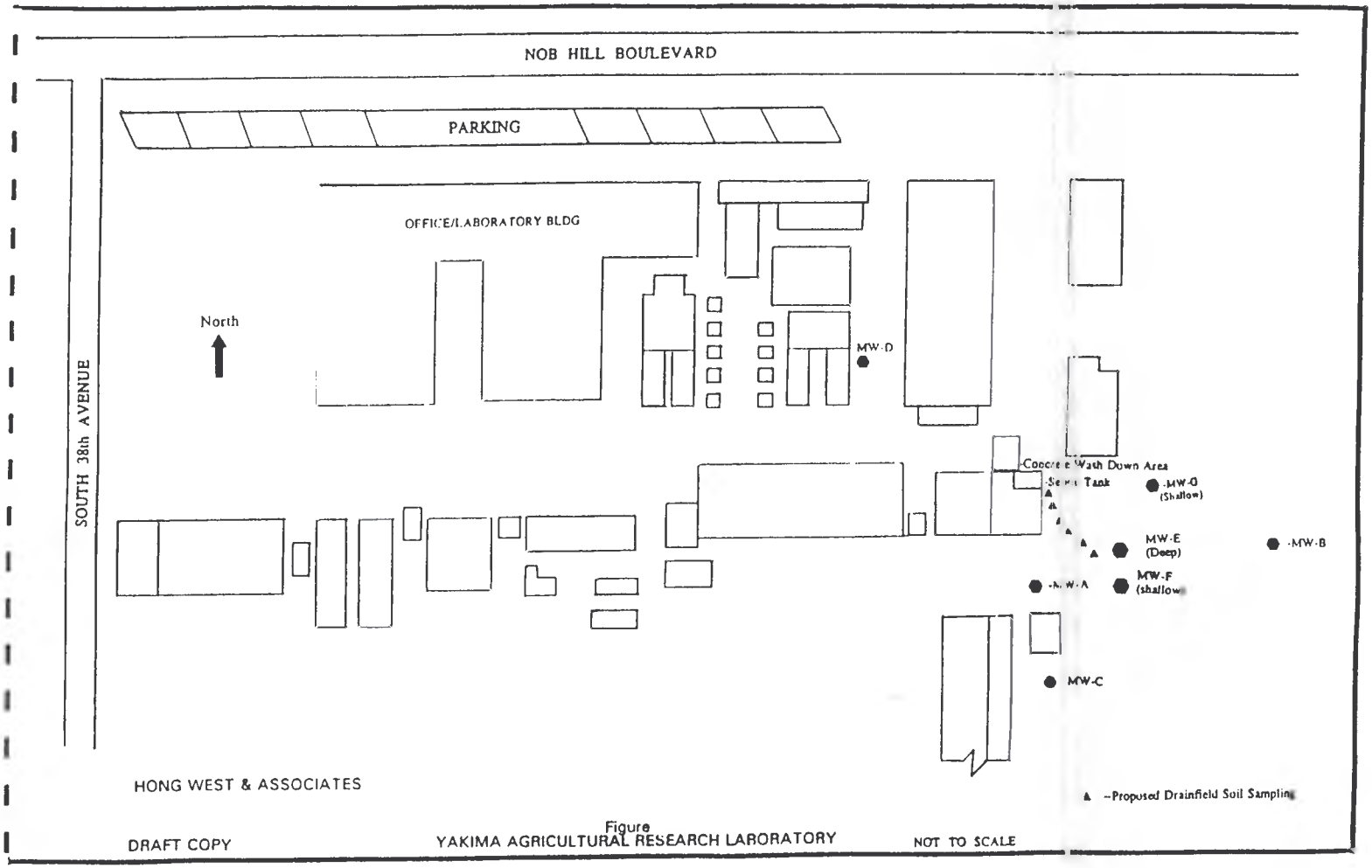
FIGURE 1-1

Site Location Map



Source: Tetra Tech (1989)

FIGURE 1-2
DETAILED SITE MAP



Figure

Modified from Hong West (1990a)

TABLE 1-1

Monitoring Wells Selected for Split Sampling

Monitoring Well	Selection Criteria
MW-D	Upgradient; Screened in top 10 feet of aquifer in sandy gravel
MW-G	Crossgradient and downgradient; Screened in top 10 feet of aquifer in sandy gravel; New well
MW-A	Downgradient; Screened in top 10 feet of aquifer in sandy gravel; Moderate levels of contamination
MW-F	Downgradient; Screened in top 10 feet of aquifer in sandy gravel; New well
MW-E	Downgradient; Piezometer at depth of 125 feet; New well

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The EPA work assignment manager has primary management responsibility for the O&M inspection. PRC is responsible for conducting field sampling activities, validating data, and reporting results. A project organization chart outlining major quality assurance responsibilities is presented in Figure 2-1.

The following subsections outline responsibilities and responsible individuals for four separate aspects of the O&M inspection: management, quality assurance, field operations, and laboratory services.

2.1 MANAGEMENT RESPONSIBILITIES

Responsibility for technical and administrative management is assigned as follows:

- EPA Regional Project Officer (Vicky Tapang) -- Overall management of TES 12 RCRA work assignments
- EPA Work Assignment Manager (Marcia Bailey) -- Management of the YARL O&M inspection
- PRC Regional Manager (Jim Pankanin) -- Overall management of all TES 12 work assignments in EPA Region 10
- PRC Project Manager (Jim Pankanin) -- Management of the YARL O&M inspection

2.2 QUALITY ASSURANCE RESPONSIBILITIES

The following organizations and individuals are responsible for quality assurance:

- EPA Work Assignment Manager (Marcia Bailey) -- Review and approval of QAPjP; review and approval of O&M inspection report
- EPA Region 10 Quality Assurance Officer (Barry Towns) -- Review and approval of QAPjP
- PRC TES 12 Quality Assurance Manager (Dave Liu) -- Overall quality assurance for TES 12 work assignments
- PRC Regional QAPjP Technical Monitor (Jeff Ross) -- Technical review of QAPjP
- PRC Project Manager (Jim Pankanin) -- Approval of QAPjP

2.3 FIELD SAMPLING RESPONSIBILITIES

PRC is responsible for performing all specified field sampling activities under the direction of EPA. Specific field sampling responsibilities are as follows:

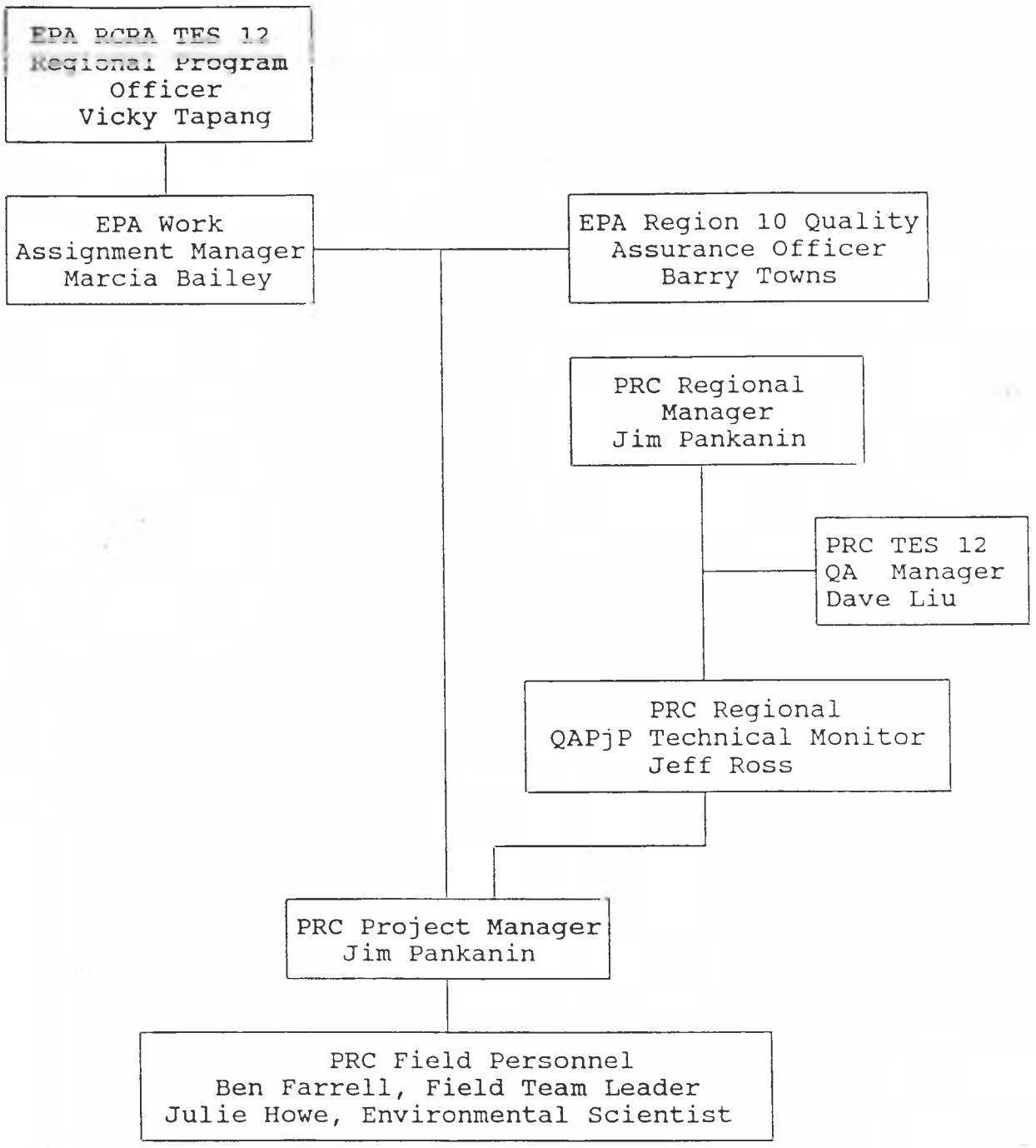
- EPA Work Assignment Manager (Marcia Bailey) -- Overall direction of field sampling
- PRC Project Manager (Jim Pankanin) -- Technical direction of field sampling
- PRC Field Team Leader (Ben Farrell) -- Direction and coordination of field sampling

2.4 LABORATORY RESPONSIBILITIES

Laboratory analysis of split groundwater samples will be conducted through the EPA Region 10 Manchester laboratory or a CLP laboratory, depending on laboratory availability. The EPA quality assurance officer (Barry Towns) will coordinate and manage all EPA and CLP responsibilities for split groundwater samples.

FIGURE 2-1

Project Organization Chart



3.0 QUALITY ASSURANCE AND QUALITY CONTROL OBJECTIVES

This section addresses QA/QC objectives for completeness, representativeness, comparability, precision, and accuracy of data. The overall objective is to develop and implement procedures for field sampling activities, chain-of-custody, laboratory analysis, and reporting that will promote high quality data. Sections 3.1, 3.2, and 3.3 discuss QA/QC objectives for completeness, representativeness, and comparability. Section 3.4 discusses QA/QC objectives for precision and accuracy for method SW-846 analytical procedures.

3.1 COMPLETENESS

Completeness is measured by the amount of valid analytical data obtained compared to the amount of analytical data expected under normal conditions. "The amount of analytical data expected under normal conditions" is defined as the total number of environmental and QA/QC samples planned to be received and analyzed for the groundwater monitoring system. For this project, the completeness criterion for both field and laboratory is 85 percent.

3.2 REPRESENTATIVENESS

Representativeness is the degree to which sample data represent a characteristic of a population or an environmental condition. Sampling locations are selected to obtain (receive) representative groundwater samples that will determine if there is a release to the environment at the YARL site (see Section 1.6).

Representativeness is enhanced when all samples from a particular medium are collected using the same technique. For this effort, split groundwater samples will be collected (received) according to sampling procedures outlined in Section 4.

3.3 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. To assure that groundwater results are comparable to future sample results, PRC will document all sample locations, conditions, field sampling methods, and laboratory analysis

methods. SW-846 analytical methods will be used in order to duplicate the analytical methods used by the contractor.

3.4 PRECISION AND ACCURACY

Precision and accuracy are indicators of data quality. Generally, precision is a measure of the variability of a group of measurements compared to their mean value. Sampling and analytical precision is determined by analyzing field duplicate samples. Accuracy is a measure of the bias in a measurement system. Sampling accuracy is assessed by analyzing equipment rinsate field blanks, trip blanks, and field (transfer) blanks. Analytical accuracy is assessed by analyzing surrogate and matrix spike samples.

The QA/QC samples to be received for determining precision and accuracy are described below and in Section 8. Because the well monitoring sampling system at the site is fully dedicated, equipment rinsate field blanks are not necessary. Precision and accuracy objectives for SW-846 methods and field sample analysis are also described below and summarized in Table 3-1.

3.4.1 Types of Quality Assurance and Quality Control Samples

Four types of QA/QC samples will be received to determine precision and accuracy: field duplicates, trip blanks, field (transfer) blanks, and matrix spike/matrix spike duplicate (MS/MSD) samples. One duplicate sample will be received from the monitoring well system and submitted for laboratory analysis to determine sampling and analytical precision. One trip blank sample will be included in every cooler shipped to the laboratory that contains environmental samples for VOC analysis. The trip blanks will be analyzed for target compound list VOCs to check for contamination potentially occurring during shipping and handling (sampling accuracy). One field (transfer) blank will be prepared for each day of sampling. The field (transfer) blank will be analyzed for target compound list VOCs to check for potential contamination from on-site ambient conditions (sampling accuracy). MS/MSD samples also will be received from each system. MS/MSD samples will be analyzed and used to determine analytical accuracy. Percent recovery values for these samples will be compared to acceptance criteria established by EPA (1986a, 1987).

3.4.2 Analytical Quality Assurance and Quality Control Objectives

Criteria for precision and accuracy defined in by EPA (1986a, 1987) will serve as data quality objectives. Method detection limits follow SW-846 methods. Table 3-1 summarizes the data quality objectives for the SW-846 analytes.

3.4.3 Field Quality Assurance and Quality Control Objectives

Field measurements of volatile organic vapors will be made at the site for health and safety reasons using an HNu model P-101 photoionization detector. Field measurement, calibration, and maintenance procedures for the instrument are described in the operators manual, provided in Appendix A.

TABLE 3-1
DATA QUALITY OBJECTIVES

Analytical Parameter	Method Detection Limit (µg/L)	Precision (Relative Percent Difference)	Accuracy (Percent Spike Recovery)	Completeness (Percent)	Analytical Method
Volatile Organic Compounds	See EPA (1986a)	±25	80 - 120	85	SW-846 Method 8240
Organo-chlorine Pesticides	See EPA (1986a)	±25	60 - 140	85	SW-846 Method 3510/3620/8080
Organo-phosphorous Pesticides	See EPA (1987)	±25	60 - 140	85	SW-846 Method 3510/3620/8140
Chlorinated Herbicides	See EPA (1986a)	±25	60 - 140	85	SW-846 Method 8150
Total Metals	See EPA (1986a)	±25	80 - 120	85	SW-846 Method 3005/6010
Total Hg	See EPA (1986a)	±25	80 - 120	85	SW-846 Method 7470
Dissolved Metals	See EPA (1986a)	±25	80 - 120	85	SW-846 Method 3005/6010
Total Hg	See EPA (1986a)	±25	80 - 120	85	SW-846 Method 7470

4.0 SAMPLING PROCEDURES

PRC will receive split groundwater samples at the YARL site as part of the O&M inspection. PRC will also receive and submit appropriate QA/QC samples for the monitoring well system. The QA/QC samples are discussed in Sections 3 and 8. A summary of the sampling program is presented in Table 4-1.

4.1 SPLIT GROUNDWATER SAMPLING OF MONITORING WELLS

Split groundwater samples will be received from five on-site monitoring wells in the following order: MW-D, MW-G, MW-A, MW-F, and MW-E (see Table 4-1 and Figure 1-2). This order of sampling is specified by YARL. These five monitoring wells represent both upgradient and downgradient locations, and various depths. Well selection is summarized in Table 1-1.

PRC will also receive QA/QC samples, including a duplicate sample and MS/MSD samples (MW-A), and a trip blank and field (transfer) blank (Table 4-1). QA/QC samples are discussed in detail in Section 8. To receive split groundwater samples, PRC will provide the appropriate sample containers, preservatives, shipping coolers, and miscellaneous field supplies, as listed in Table 4-2. PRC will receive a split sample for each analyte immediately after YARL collects a groundwater sample for that analyte. For each analyte, YARL and PRC containers for that sample will be filled alternately, one container at a time, until all containers are filled.

Because YARL is not collecting field-filtered metals samples as part of the sampling effort, PRC will provide field filtering equipment (0.45-micron filtering containers and hand-held vacuum pump). PRC will collect the filtered metals samples by holding the field filtering containers to be filled by YARL. PRC will filter the samples using the hand-held vacuum pump, then transfer the filtered samples to the appropriate containers.

After each split groundwater sample set is received by PRC at each well (or prepared by PRC, in the case of filtered metals samples), PRC will preserve the samples for VOC, organo-chlorine pesticides, organo-phosphorous pesticides, chlorinated herbicides, and total and dissolved metals analyses. VOC samples will be preserved prior to filling the volatile organic analysis

(VOA) vials. VOA vials will be filled with no headspace. Table 4-2 specifies the holding times, preservatives, and containers required for the sampling event.

The split groundwater samples and QA/QC samples received will be analyzed by the EPA Region 10 Manchester laboratory or a CLP laboratory, depending on availability. The samples will be analyzed by SW-846 methods for the various chemical contaminants. See Table 3-1 for a summary of the exact analytical methods.

4.2 DECONTAMINATION PROCEDURES

Decontamination of sampling equipment will be performed by YARL following the sampling and analysis plan. Contamination of nondisposable items during the receiving of split samples is not anticipated. Contaminated disposable items such as latex gloves, groundwater filters, and used (empty) collection containers will be placed in plastic garbage bags and disposed of by YARL.

TABLE 4-1
SAMPLING PROGRAM

Sample Designation	Sample Matrix	Analytical Parameter[a]	Environmental Sample[a]	Environmental Field Dupl.[b]	Trip Blank[c]	Field Blank[d]
MW-D	Water	VOC	1			
	(split grab sample)	Pesticides and Herbicides	1			
		Total metals	1			
		Dissolved metals	1			
MW-G	Water	VOC	1			
	(split grab sample)	Pesticides and Herbicides	1			
		Total metals	1			
		Dissolved metals	1			
MW-A	Water	VOC	1			
(MS/MSD)	(split grab sample)	Pesticides and Herbicides	1			
		Total metals	1			
		Dissolved metals	1			
MW-K	Water	VOC		1		
(duplicate of MW-A)	(split grab sample)	Pesticides and Herbicides		1		
		Total metals		1		
		Dissolved metals		1		

TABLE 4-1 (continued)
SAMPLING PROGRAM

Sample Designation	Sample Matrix	Analytical Parameter[b]	Environmental Sample[a]	Environmental Field Dupl.[b]	Trip Blank[c]	Field Blank[d]
MW-F	Water	VOC	1			
	(split grab sample)	Pesticides and Herbicides	1			
		Total metals	1			
		Dissolved metals	1			
MW-E	Water	VOC	1			
	(split grab sample)	Pesticides and Herbicides	1			
		Total metals	1			
		Dissolved metals	1			
MW-I	Water (blank)	VOC			1	
MW-J	Water (blank)	VOC				1

TABLE 4-1 (continued)
SAMPLING PROGRAM

Sample Designation	Sample Matrix	Analytical Parameter[b]	Environmental Sample[a]	Environmental Field Dupl.[b]	Trip Blank[c]	Field Blank[d]
TOTAL SAMPLES						
		VOC	5	1	1	1
		Pesticides and Herbicides	5	1		
		Total metals	5	1		
		Dissolved metals	5	1		

a Matrix spike/matrix spike duplicate (MS/MSD) samples are required for SW-846 analyses. One set of MS/MSD samples will be collected at MW-A. Triple volumes are required for organic analyses; double volumes are required for inorganic MS/MSD analyses. However, MS/MSD samples do not count toward the sample total and are not included in the table as a separate item.

b One field duplicate will be taken at well MW-A.

c Each trip blank consists of two 40-mL volatile organic analysis (VOA) vials filled with carbon-free water by the analytical laboratory. The trip blanks will be shipped with the other samples for volatile organic compound (VOC) analyses. One trip blank will be shipped with each cooler containing VOC samples.

d The field (transfer) blank consists of two 40-mL VOA vials filled with carbon-free water in the field by PRC personnel.

TABLE 4-2
SAMPLE HOLDING TIME, PRESERVATION, AND CONTAINER REQUIREMENTS

Analytical Parameters	Matrix	Holding Times[a]	Preservation[a]	Containers per Sample, Blank, or MS/MSD[b]	Total Samples and Blanks	Total Containers Required (Including MS/MSD)[b]
Volatile Organic Compounds	Water	14 days	Four drops concentrated HCl. Cool to 4°C	2 x 40-mL glass vials, Teflon-lined septum caps	8	20
Pesticides and herbicides[c]	Water	Extraction within 7 days, Analysis within 40 days after extraction	Cool, 4°C pH 5-9	2 x 2-L amber glass with Teflon liner	6	16
Total Metals	Water	6 months (28 days for Hg)	HNO_3 to pH<2	1 x 1-L polyethylene	6	7
Dissolved Metals	Water	6 months (28 days for Hg)	Field filter using 0.45 micron screen, HNO_3 to pH<2	1 x 1-L polyethylene	6	7

a EPA (1986a)

b Matrix spike/matrix spike duplicate (MS/MSD) samples are required for SW-846 analyses. One set of MS/MSD samples each will be collected at well MW-A. Triple volumes are required for organic portions of the MS/MSD analyses; double volumes are required for inorganic portions of the MS/MSD analyses

c Organo-chlorine pesticides; organo-phosphorous pesticides, chlorinated herbicides

5.0 SAMPLE DOCUMENTATION AND CUSTODY

The possession and handling of each sample will be properly documented to promote timely, correct, and complete analysis for all parameters requested. Each sample must be traceable from the point of collection (receiving) through analysis and final disposition to promote sample integrity, in order to preclude any possible challenge of the analytical data in litigation or enforcement actions.

The CLP and EPA documentation system is used to identify, track, and monitor each sample. This system is discussed briefly in the following sections. EPA (1988a) provides further information concerning these procedures. Additional field records and control measures will be maintained according to EPA (1986b). Whenever questions arise, the EPA regional sample control center (RSCC) will be consulted for direction and clarification.

5.1 FIELD DOCUMENTATION AND CONTROL MEASURES

The field records and CLP and EPA documentation control measures to be used during sample receiving, identification, handling, and shipping include the following:

- Sample tags, as shown in Figure 5-1
- Custody seals, as shown in Figure 5-1
- CLP sample analysis request forms (traffic report forms), as shown in Figures 5-2 and 5-3
- EPA Region 10 laboratory analysis request forms (organics and metals), as shown in Figures 5-4 and 5-5
- Chain-of-custody record, as shown in Figure 5-6

All necessary CLP and EPA documentation forms, labels, seals, and other paperwork will be obtained from the EPA RSCC. The PRC project manager is responsible for obtaining these items and distributing them to field personnel. All paperwork will be completed using indelible ink.

5.1.1 Sample Labeling

PRC will use the official EPA and CLP sample numbers issued by the EPA (RSCC) for this split-sampling event. In a bound logbook, the official EPA and CLP sample numbers will be recorded and cross-referenced to corresponding PRC split-sample designations (see Section 5.1.2). The PRC split-sample numbering system consists of:

- A two-letter site description (YA for Yakima Agricultural)
- A multi-character sample designator (for example, monitoring well MWE)
- A two-character sampling-round number (for example, 01, designating the round of sampling at the site)

Thus, the split groundwater sample from monitoring well MW-E at YARL, taken on the first sampling round at the site, is designated YA-MWE-01.

A sample tag and a label are attached to each sample container to provide proper identification of samples. The tags are retained by the laboratory as evidence of sample receipt and analysis.

Figure 5-1 shows a typical sample tag. The information recorded on tags and labels includes the following:

- Project code--the number assigned by EPA to the sampling project
- Laboratory sample number--assigned by EPA RSCC
- CLP case number(s)--the unique number(s) for CLP analyses assigned by EPA RSCC to identify the sampling event (entered under Remarks heading)
- CLP sample number--the unique CLP sample identification number assigned by EPA RSCC to document the sample (entered under Remarks heading)
- Station location--the sampling station description as specified in the QAPjP
- Station number--a two-digit number assigned by the field team leader
- Date--a six-digit number indicating the month, day, and year of receiving
- Time--a four-digit number indicating the military time of receiving

- Sample type--grab or composite
- Total number of sample containers
- Sampling personnel--signatures of sample receivers
- Remarks--Case and sample numbers, as well as any pertinent comments
- Label or tag number--a unique serial number preassigned and stamped on the label or tag

The tag and label also have appropriate spaces for describing sample preservatives and indicating the analytical parameters. The completed sample tag and label are securely attached to the sample container.

PRC will consult the EPA RSCC personnel for assistance regarding the analytical services to be used. Appropriate analysis requests and records will be used according to guidelines specified by EPA (1988a).

5.1.2 Field Logbook

Daily field activities are documented through journal entries in a bound field logbook, dedicated to the site. The logbook is water resistant, and all entries are made in indelible ink. The logbook contains all pertinent information about sampling activities, site conditions, field methods used, general observations, and other pertinent technical information. Examples of typical logbook entries include the following:

- Daily temperature and other climatic conditions
- Field measurements, activities, and observations
- Referenced sampling location description (in relation to a stationary landmark)
- Media sampled
- Collection (receiving) methods and equipment, including decontamination measures
- Date and time of receiving
- Types of sample containers used

- Sample identification and cross-referencing
- Sample types and preservatives used
- Analytical parameters
- Sample receivers, distribution, and transporters
- Site sketches
- Instrument calibration procedures and frequency

The PRC field team leader or designee is responsible for the daily maintenance of all field records. Each page of the logbook is numbered, dated, and signed by the person making the entry. Corrections to the logbook are made by using a single strike mark through the entry to be corrected, then recording and initialing the correct entry. For corrections made at a later date, the date of the correction is noted.

Color photographs are taken during the inspection to document sampling locations, monitoring well maintenance, sampling activities, and other site features, as necessary. The photographs are numbered to correspond to logbook entries. The name of the photographer, date, time, site location, and photo description are entered sequentially as photos are taken. Adequate logbook notations and receipts are retained to account for custody during film processing.

5.1.3 Chain-of-Custody Record

A chain-of-custody record, shown in Figure 5-6, establishes the documentation necessary to trace sample possession from time of receiving through sample analysis and disposition. A sample is in the custody of a person if any of the following criteria are met:

- The sample is in a person's physical possession
- The sample is in a person's view after being in his or her physical possession
- The sample was in a person's physical possession and was then locked up or sealed to prevent tampering
- The sample is kept in a secured area

The sample receiver completes a chain-of-custody record to accompany each sample delivery container (cooler) and is responsible for shipping samples from the field to the laboratory. The sample receiver provides the project number, the CLP case number, and the sample receiver's signature as header information on the chain-of-custody record. The common name of the site is not included in this form or other sample documentation, because CLP laboratories may perform analyses for responsible parties associated with the site. For each station number, the sample receiver indicates the date, time, sample status (composite or grab sample), station location, number of containers, analytical parameters, EPA sample numbers, and CLP sample numbers. When shipping the samples, the sample receiver signs the bottom of the form and enters the date and time (military) that the samples were relinquished. The sample receiver enters the carrier name and air bill number on the form. The original signature copy of the chain-of-custody record is enclosed in a plastic bag (along with any other necessary CLP or EPA sample documentation) and secured to the inside of the cooler lid. A copy of the chain-of-custody record is retained for PRC files.

Each shipping cooler is secured for shipment by placing custody seals across all four sides of the cooler lid. Commercial carriers are not required to sign the chain-of-custody form, provided that the form is sealed inside the shipping cooler and the custody seals remain intact.

5.2 LABORATORY CUSTODY PROCEDURES

The EPA Region 10 Manchester laboratory or CLP laboratories performing the chemical analyses are responsible for following all CLP-required chain-of-custody procedures specified by EPA (1990a,b).

FIGURE 5-1

Typical Sample Tag and Custody Seal

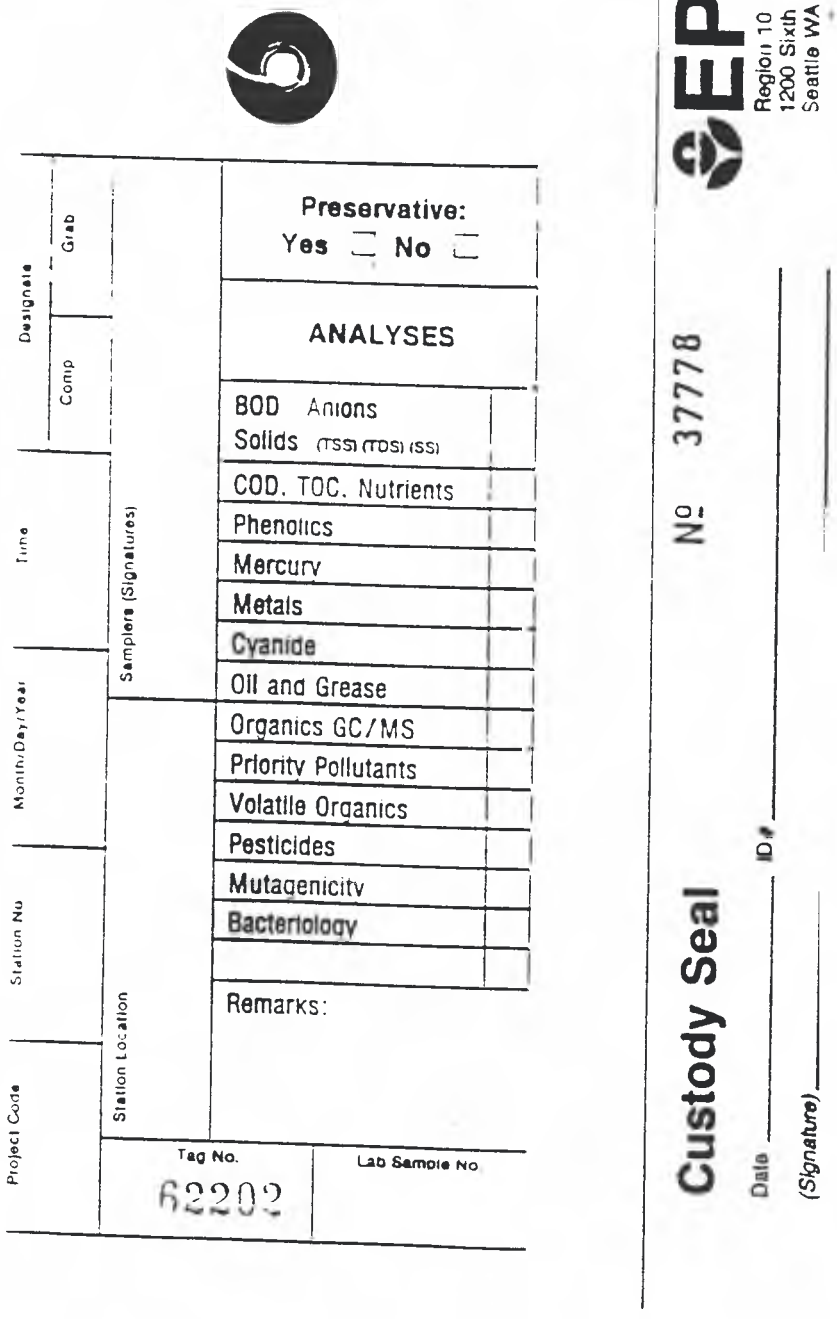


FIGURE 5-2

Organic Sample Analysis Request Form

EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Organic Traffic Report
(For CLP Use Only)

Case Number | SAS No. (If Applicable)

1. Type of Activity (Check one)
ENF NPLD RA SI STSI
ER O&M RD ST Other *(Specify)*
ESI PA RIFS STPA

2. Region Number | Sampling Co.

Sampler (Name)

4. Date Shipped | Airbill Number

Carrier

5. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (SAS)
7. Waste (SAS)
8. Other (SAS) *(Specify)*

Non-Superfund Program

Site Name

City, State | Site Spill ID

3. Ship To

Triple volume required for matrix spike/duplicate aqueous sample.

Ship medium and high concentration samples in paint cans.

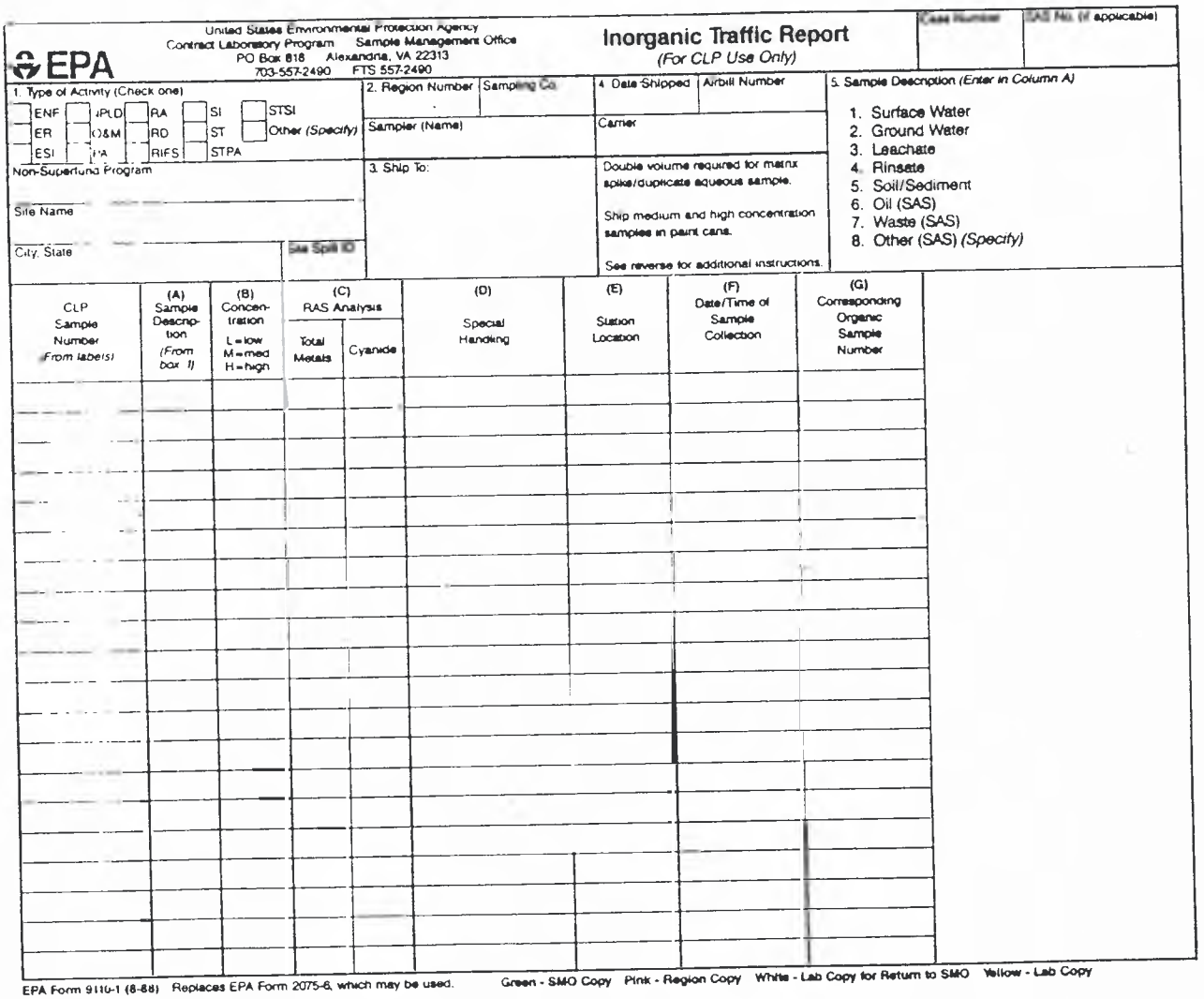
See reverse for additional instructions.

CLP Sample Number (From labels)	(A) Sample Description (From box 5)	(B) Concentration L=low M=med H=high	(C) RAS Analysis VOA	BNA	Pest/ PCB	(D) Special Handling	(E) Station Location	(F) Date/Time of Sample Collection	(G) Corresponding CLP Inorganic Sample Number

EPA Form 9110-2 (8-88) Replaces EPA Form 2075-7, which may be used. Blue - SMO Copy Pink - Region Copy White - Lab Copy for Return to SMO Yellow - Lab Copy

FIGURE 5-3

Inorganic Sample Analysis Request Form



EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Inorganic Traffic Report
(For CLP Use Only)

Case Number | SAS No. (if applicable)

1. Type of Activity (Check one)
☐ ENF ☐ UPLD ☐ RA ☐ SI ☐ STSI
☐ ER ☐ O&M ☐ RD ☐ ST ☐ Other *(Specify)*
☐ ESI ☐ PA ☐ RIFS ☐ STPA

Non-Superfund Program

Site Name

City, State | Site Spill ID

2. Region Number | Sampling Co.

Sampler (Name)

3. Ship To:

4. Date Shipped | Airbill Number

Carrier

Double volume required for matrix spike/duplicate aqueous sample.

Ship medium and high concentration samples in paint cans.

See reverse for additional instructions.

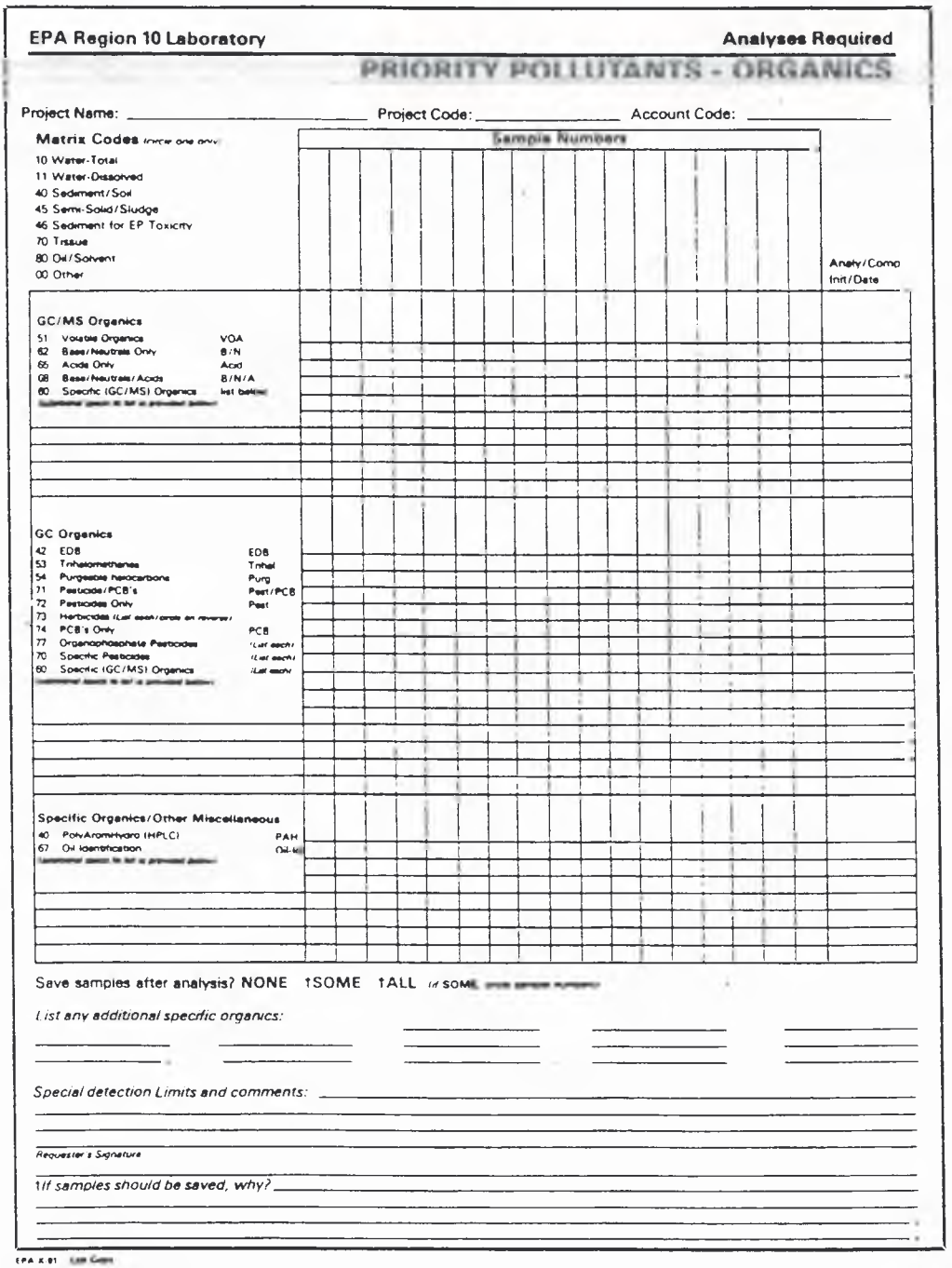
5. Sample Description *(Enter in Column A)*
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (SAS)
7. Waste (SAS)
8. Other (SAS) *(Specify)*

CLP Sample Number *(From labels)*	(A) Sample Description *(From box 1)*	(B) Concentration L=low M=med H=high	(C) RAS Analysis: Total Metals	(C) RAS Analysis: Cyanide	(D) Special Handling	(E) Station Location	(F) Date/Time of Sample Collection	(G) Corresponding Organic Sample Number

EPA Form 9110-1 (8-88) Replaces EPA Form 2075-6, which may be used. Green - SMO Copy Pink - Region Copy White - Lab Copy for Return to SMO Yellow - Lab Copy

FIGURE 5-4

EPA Region 10 Laboratory Analysis Request Form for Organics



EPA Region 10 Laboratory — **Analyses Required**

PRIORITY POLLUTANTS - ORGANICS

Project Name: _____ Project Code: _____ Account Code: _____

Matrix Codes (circle one only)
10 Water-Total
11 Water-Dissolved
40 Sediment/Soil
45 Semi-Solid/Sludge
46 Sediment for EP Toxicity
70 Tissue
80 Oil/Solvent
00 Other

Sample Numbers

Analy/Comp Init/Date

GC/MS Organics
51 Volatile Organics — VOA
62 Base/Neutrals Only — B/N
65 Acids Only — Acid
08 Base/Neutrals/Acids — B/N/A
60 Specific (GC/MS) Organics — list below

GC Organics
42 EDB — EDB
53 Trihalomethanes — Trihal
54 Purgeable Halocarbons — Purg
71 Pesticide/PCB's — Pest/PCB
72 Pesticides Only — Pest
73 Herbicides (List each/circle on reverse)
74 PCB's Only — PCB
77 Organophosphate Pesticides (List each)
70 Specific Pesticides (List each)
60 Specific (GC/MS) Organics (List each)

Specific Organics/Other Miscellaneous
40 PolyAromHydro (HPLC) — PAH
67 Oil Identification — Oil-ID

Save samples after analysis? NONE †SOME †ALL (if SOME, circle sample numbers)

List any additional specific organics:

_____ _____ _____ _____ _____
_____ _____ _____ _____ _____
_____ _____ _____ _____ _____

Special detection Limits and comments: _____

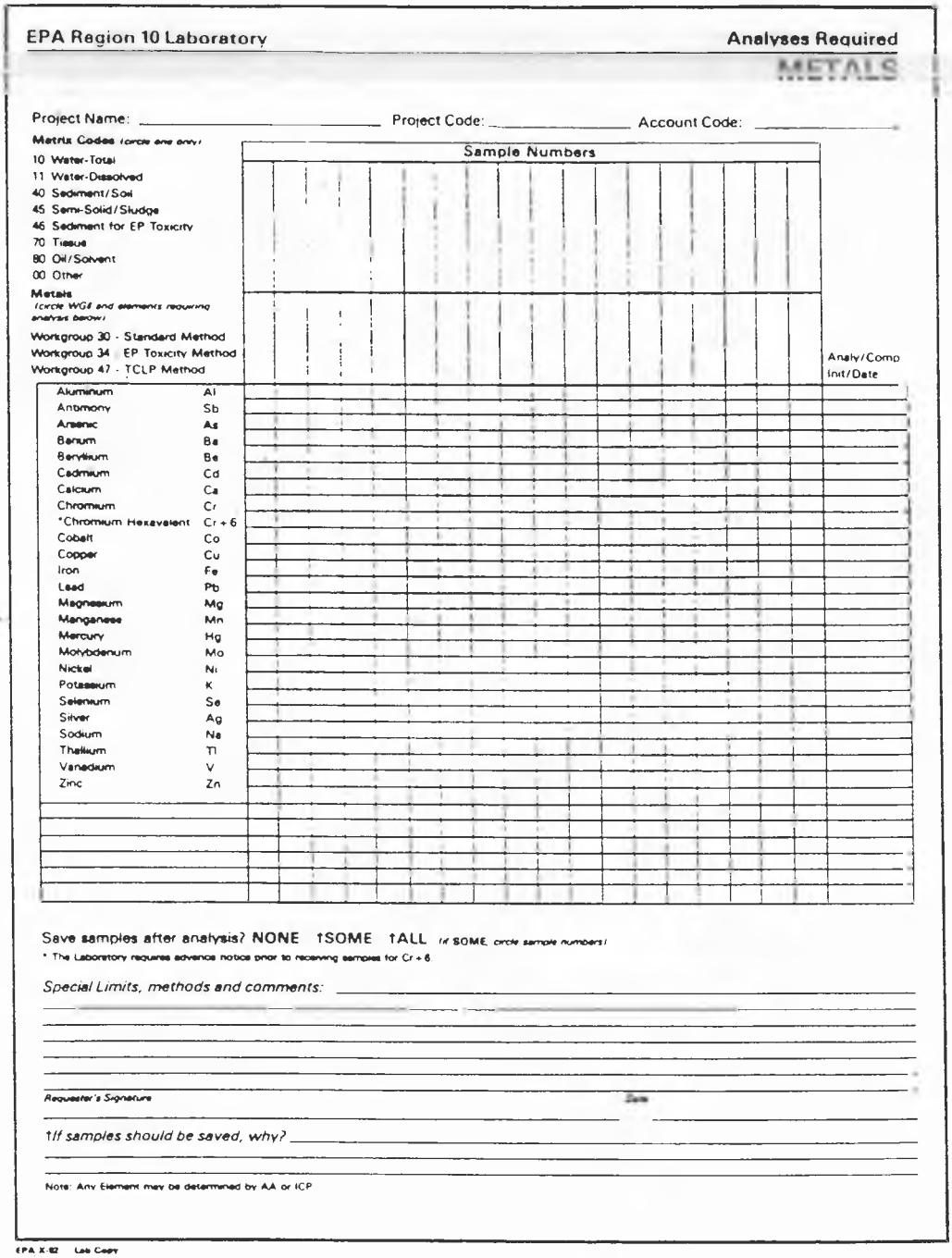
Requester's Signature

†*If samples should be saved, why?* _____

EPA X-81 (Lab Copy)

FIGURE 5-5

EPA Region 10 Laboratory Analysis Request Form for Metals



EPA Region 10 Laboratory

Analyses Required

METALS

Project Name: _____ Project Code: _____ Account Code: _____

Matrix Codes (circle one only)
10 Water-Total
11 Water-Dissolved
40 Sediment/Soil
45 Semi-Solid/Sludge
46 Sediment for EP Toxicity
70 Tissue
80 Oil/Solvent
00 Other

Metals (circle WG# and elements requiring analysis below)
Workgroup 30 - Standard Method
Workgroup 34 - EP Toxicity Method
Workgroup 47 - TCLP Method

Sample Numbers

Analy/Comp Init/Date

Aluminum	Al
Antimony	Sb
Arsenic	As
Barium	Ba
Beryllium	Be
Cadmium	Cd
Calcium	Ca
Chromium	Cr
*Chromium Hexavalent	Cr + 6
Cobalt	Co
Copper	Cu
Iron	Fe
Lead	Pb
Magnesium	Mg
Manganese	Mn
Mercury	Hg
Molybdenum	Mo
Nickel	Ni
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Thallium	Tl
Vanadium	V
Zinc	Zn

Save samples after analysis? NONE †SOME †ALL (If SOME, circle sample numbers)

* The Laboratory requires advance notice prior to receiving samples for Cr + 6.

Special Limits, methods and comments: _____

Requester's Signature *Date*

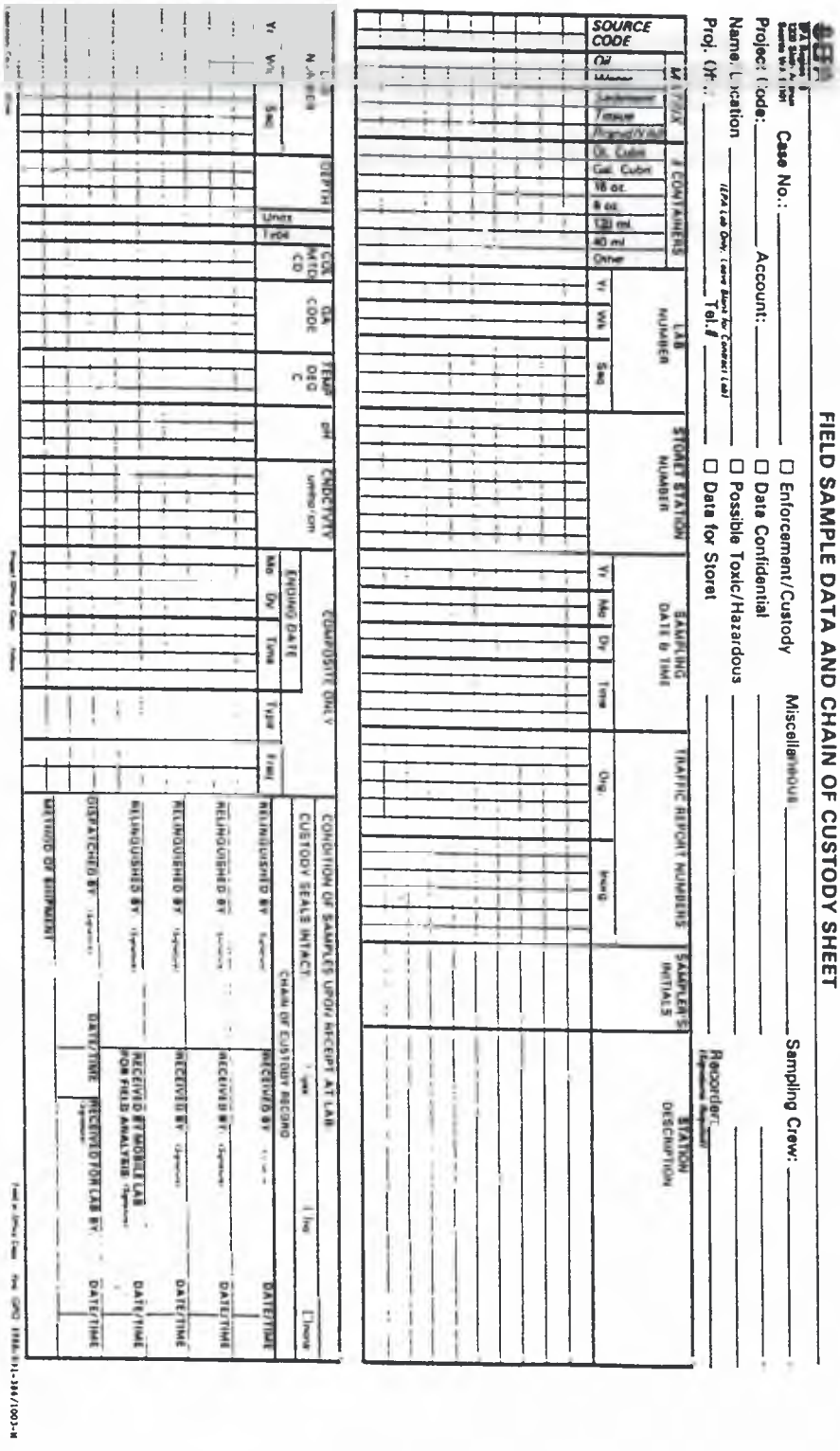
†*If samples should be saved, why?* _____

Note: Any Element may be determined by AA or ICP.

EPA X-82 Lab Copy

FIGURE 5-6

Chain-of-Custody Record



6.0 CALIBRATION PROCEDURES AND FREQUENCY

Both laboratory and field equipment must be calibrated on a regular basis to assure the accuracy of analyses. This section describes calibration procedures and frequency for measuring and testing equipment.

6.1 FIELD EQUIPMENT

PRC personnel will use an HNu model P-101 photoionization detector to monitor ambient air conditions for health and safety precautions at the site. The operators manual for the instrument is included as Appendix A. Before transport to the field, the battery and fan of the HNu will be checked to assure that they are operational, and the instrument will be calibrated with isobutylene gas supplied by the manufacturer. The unit will be calibrated again in the field before use to check against damage during transport. All calibration information, including date, time, pressure of calibration gas, span setting of the instrument, and name of the equipment operator, will be recorded in the field logbook.

6.2 LABORATORY EQUIPMENT

Laboratory calibration requirements for the SW-846 analytical procedures can be found in the SW-846 methods (EPA, 1986a, 1987).

7.0 ANALYTICAL PROCEDURES

This section describes the field and laboratory analytical procedures to be used during the O&M inspection.

7.1 FIELD ANALYTICAL PROCEDURES

PRC will perform ambient air monitoring using an HNu photoionization detector to screen for the presence of volatile organic vapors that may produce a health and safety hazard. The HNu detects a variety of VOCs but does not identify discrete compounds without direct calibration. The instrument measures VOCs relative to isobutylene (see Appendix A), providing an approximate measurement of total VOCs.

7.2 LABORATORY ANALYTICAL PROCEDURES

The EPA Region 10 Manchester laboratory or a CLP laboratory, depending on availability, will provide analytical support. The levels of precision and accuracy specified by SW-846 methods for organic and inorganic analyses (EPA, 1986a, 1987) serve as data quality objectives for the SW-846 procedures and are consistent with the ranges provided in Table 3-1.

8.0 INTERNAL QUALITY CONTROL CHECKS

An internal quality control system establishes a set of routine procedures designed to produce data that meet the QA/QC objectives (see Section 3). Inherent in this control function is a parallel function of measuring and defining the quality of the data. A well designed internal quality control program must be capable of measuring and controlling the quality of the data in terms of precision and accuracy.

The internal quality control measures described in the following sections are used to assure a high degree of data precision and accuracy.

8.1 FIELD QUALITY CONTROL CHECKS

As a quality control check on field sampling, PRC will receive field duplicate samples, trip blanks, and field (transfer) blanks to be sent to the laboratory at specified frequencies discussed in Section 3.4.

Field quality control checks also include regular and continuing calibration of all field measuring equipment. This field equipment includes an HNu model P-101 photoionization detector used to monitor for volatile organic vapors. Calibration procedures for the instrument are described in Section 6.1 and Appendix A.

8.1.1 Field Duplicate Samples

A field duplicate sample is defined as one additional sample collected or received independently at a sampling location during a sampling event. The number of field duplicates specified for each analyte is presented in Table 4-1. Field duplicate sample containers are filled alternately between environmental samples (see Section 4.1).

Field duplicates are identified so that the laboratory cannot distinguish them from other samples. For each sample matrix, one complete sample set is identified with a coded (false) identifier in the same format as other identifiers used for this sample matrix. Both the coded and true identifiers are recorded in the field logbook. On chain-of-custody forms, the coded

identifier is used. These coded field duplicates are used to assess the representativeness of the sampling procedure as well as laboratory analytical precision.

8.1.2 Trip Blanks

A trip blank consists of sample containers (two 40-mL VOA vials) filled with carbon-free water by the EPA Region 10 Manchester laboratory. The trip blank is carried into the field and handled like a sample but not opened. The trip blank is returned to the laboratory for analysis along with the other environmental samples. The trip blank is analyzed only for VOCs and is used to determine if contaminants were introduced during sample handling and shipment. One trip blank is included with each shipment of VOC samples sent to the laboratory.

8.1.3 Field (Transfer) Blanks

A field (transfer) blank consists of sample containers (two 40-mL VOA vials) filled with carbon-free water in the field by PRC personnel at an environmental sample location. The field (transfer) blanks are returned to the laboratory for analysis along with the other environmental samples. The field (transfer) blanks are analyzed only for VOCs and are used to determine if contaminants were introduced from ambient conditions during sample collection (receiving). One field (transfer) blank is prepared for each day of sampling.

8.2 LABORATORY QUALITY CONTROL CHECKS

Quality control data are necessary to determine precision and accuracy of analyses and to demonstrate that interferences and contamination of glassware and reagents are absent. The SW-846 methods include the use of laboratory blanks, MS/MSD samples, initial and continuing calibration, and other measures as specified by EPA (1986a, 1987).

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The data reduction, validation, and reporting process includes all steps between the original instrument or visual reading and the data validation report. Data reduction includes laboratory calculations for unit conversions, dilutions, and similar factors. To validate the data, someone other than the laboratory analyst reviews the data reduction procedures to determine the acceptability of the data and any necessary qualifiers. Reporting includes transcribing these validated data into a final report and interpreting them. Data reduction and data validation differ among analytical methods, but the reporting process is common to all data.

9.1 DATA REDUCTION

The EPA Region 10 Manchester laboratory and CLP laboratories performing SW-846 analyses are required to follow data reduction procedures as established by EPA (1988b,c).

Field parameters such as volatile organic vapors are measured by direct reading of instruments. Results are recorded directly into field logbooks; thus no data reduction is required.

9.2 DATA VALIDATION

This section outlines data validation procedures for both field and laboratory measurements.

9.2.1 Field Measurements

All field data will be generated by qualified field personnel and immediately entered into a field logbook. These data will be reviewed daily by the field team leader for completeness, consistency, and proper procedures (such as calibration).

9.2.2 Laboratory Measurements

If samples are analyzed by the EPA Region 10 Manchester laboratory, EPA will perform the data validation of 100 percent of all original data. If samples are analyzed by a CLP laboratory, independent data validation of 100 percent of the original data will be performed by

PRC personnel not currently involved in this project. Validation of all data by EPA or PRC will be carried out in accordance with EPA (1988b,c).

9.3 DATA REPORTING

All data from EPA Region 10 Manchester laboratory and CLP laboratories are reported in a standard CLP SW-846 deliverable format. All data generated in the field are collected in a project file at the PRC Seattle office. All laboratory reports and other data are also placed in this file, which is organized to allow ready identification and retrieval of any desired information.

Quantitative information is entered into databases and printed out, checked against the original data sheets, and corrected before use. The resulting databases are supplemented by the text of the O&M inspection report, including data interpretation. Each PRC report is reviewed by a technical editor, a technical reviewer, and a quality control coordinator before release.

10.0 PERFORMANCE AND SYSTEM AUDITS

All laboratory and field work conducted for the YARL O&M inspection is subject to performance and system audits. A performance audit checks the operation of a specific study component, such as a sampling method or an analytical procedure. A system audit is broader and includes a thorough evaluation of both laboratory and field QA/QC methods, such as data validation procedures, corrective action procedures, and sample custody procedures. Audits may be internal (conducted by PRC personnel within the organization being audited) or external (conducted by EPA or another outside agency).

Audits are randomly scheduled by QA/QC personnel and generally are not announced beforehand. If QA/QC personnel find an apparent systematic problem with a particular component of the sampling and analysis program, they normally perform a series of audits on related activities to identify and correct the problem. Audit results are incorporated into the project reporting system, normally in the monthly report.

10.1 LABORATORY AUDIT

Performance and system audits of CLP laboratories are the responsibility of EPA. Specific details are included within CLP documents (such as EPA, 1990a,b) and in the standard operating procedures of each laboratory. If required, internal audits are conducted by personnel from CLP laboratories performing the analyses. External audits, if required, are usually performed by the EPA Environmental Monitoring Systems Laboratory in Las Vegas. Audits of CLP laboratories also may be conducted by the National Enforcement Investigations Center in Denver.

10.2 FIELD AUDIT

Internal performance and system audits of all PRC field activities are coordinated by the PRC TES 12 quality assurance manager, Dave Liu, in accordance with PRC (1988). If a field audit is scheduled, a site-specific audit checklist is prepared (Figure 10-1) based on information contained in the QAPjP and the health and safety plan. Using the checklist, auditors evaluate the compliance of field personnel with procedures specified in these plans, including the following:

- Initial and continuing equipment calibration

- Field measurements
- Sample collection (receiving)
- Sample labeling, handling, and custody
- Data collection and recordkeeping
- Health and safety monitoring
- Logbook completeness
- Photographic documentation
- Availability of documents used to evaluate YARL's compliance

External field audits for this project are the co-responsibility of EPA Region 10.

FIGURE 10-1
Audit Report Form

PRC Environmental Management, Inc.

Audit Report QA/QC Level ____

Project/Contract No.: _____

Work Assignment No. _____ Work Assignment Manager: _____

Region: _____ Firm: _____

Date of Audit: _____

Auditor: _____

Brief Description of Work Assignment:

_____

_____

_____

Audit Summary:

_____

_____

_____

Corrective Action Required:

_____

_____

_____

Remarks:

_____

_____

_____

Auditor Signature: _____ Date: _____

Distribution: 1) Original to project file 2) Copy to QA/QC file 3) Copy to auditor

11.0 PREVENTIVE MAINTENANCE

Preventive maintenance includes inspecting, repairing, and adjusting equipment and instruments before any deficiencies can have a significant effect on performance. These techniques are a necessary part of the procedures for carrying out a particular operation with a particular type of equipment.

11.1 LABORATORY EQUIPMENT

The EPA Region 10 Manchester laboratory or the CLP laboratory that analyzes the groundwater samples will follow necessary preventive maintenance actions described in its internal standard operating procedures. These actions include (1) initial and continuing tuning and calibration of instruments, (2) use of internal standards, and (3) related activities such as corrective action.

11.2 FIELD EQUIPMENT

PRC performs regular preventive maintenance of its field equipment. All field monitoring and analytical equipment is maintained in accordance with the manufacturers' recommended schedules and procedures. Field personnel maintain records of instrument service, calibration, and use. Instrument problems encountered in the field are described in the field logbook and dealt with on-site, if possible.

The primary preventive maintenance technique for field analyses is the preliminary calibration of equipment. As detailed in the HNu photoionization detector operators manual (Appendix A), this procedure typically includes a battery check, zero adjustment, and linearity (or high end) adjustment. If the instrument cannot be calibrated correctly, it is disassembled, cleaned, reassembled, and recalibrated.

12.0 PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The QA/QC objectives described in Section 3 must be met to satisfactorily complete the O&M inspection. This section describes the process of assessing whether those objectives are met. The assessment is part of the data reduction and validation process discussed in Section 9.

12.1 LABORATORY RESULTS

The precision of SW-846 laboratory results is determined primarily by calculating the relative percent difference (RPD) for duplicate samples, which include field duplicates, laboratory duplicates, and MS/MSD samples. The laboratory determines the accuracy of results by calculating percent recovery values for MS/MSD samples. In addition, the laboratory uses laboratory blanks, calibration standards, and internal standards to establish analytical accuracy, as specified by EPA (1986a, 1987). Completeness of all laboratory results is determined by comparing the number of validated, usable results to the number of samples planned.

12.2 CALCULATIONS

The primary statistic used for estimating precision is RPD for duplicate measurements. RPD is calculated as follows:

$$RPD = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100 \qquad (12\text{-}1)$$

where X_1 and X_2 are the results of duplicate measurements and $|X_1 - X_2|$ is the absolute value of the difference in the two measurements.

If there are three or more replicates, the relative standard deviation (%RSD) is calculated as a measure of precision:

$$\%RSD = (SD/\bar{X}) \times 100 \qquad (12\text{-}2)$$

where X is the average of the data points (X_1, X_2, . . . X_n) and SD is the standard deviation of the individual measurements.

Accuracy can be estimated by calculating the percent difference (%D) between an instrument response and a known standard:

$$\%D = (S-X)/S \times 100 \qquad (12\text{-}3)$$

where S is the concentration of a known standard and X is the measured instrument response. This determination of accuracy can be used for both laboratory and field measurements.

Alternatively, accuracy can be measured as the percent recovery (%R) from the analytical results of surrogate or analyte compounds spiked into a sample:

$$\%R = (M-N)/S \times 100 \qquad (12\text{-}4)$$

where M is the measured analyte concentration in the spiked sample, N is the concentration of the analyte in the original sample, and S is the analyte concentration spiked into the original sample. This measurement of accuracy is most appropriate for laboratory results.

Percent completeness (%C) is a measure of (1) the number of samples received compared to the number of samples required for characterization or (2) the amount of valid data obtained compared to the amount of data expected under normal conditions. In most cases, the number of samples required for characterization and the amount of data expected under normal conditions are the same as the number of samples planned, N. Thus, percent completeness can be defined as follows:

$$\%C = V/N \times 100 \qquad (12\text{-}5)$$

where V is the number of valid results and N is the total number of samples planned.

Percent completeness also can be measured as the percent of samples planned that were actually received:

$$\%C = C/N \times 100 \qquad (12\text{-}6)$$

where C is the number of samples received and N is the total number of samples planned.

13.0 CORRECTIVE ACTION

Corrective action must be initiated whenever a system is not functioning properly. The need for corrective action may be identified during performance or system audits or by the analysts themselves. Corrective action may take place in the laboratory or in the field.

13.1 LABORATORY CORRECTIVE ACTION

If a quality control audit conducted by EPA identifies a compliance problem, the problem will be reported to the work assignment manager. Major compliance problems within the CLP laboratory usually are handled between the laboratory, the CLP sample management office, and EPA Region 10. Procedures for corrective action during SW-846 sample analyses are established by EPA (1986a, 1987). Frequently, problems with EPA Region 10 and CLP analyses result from matrix effects, making results questionable (estimates, qualified J) or unusable (rejected, qualified R). The Region 10 work assignment manager, PRC project manager, and PRC TES 12 quality assurance manager will jointly determine the acceptability of data and determine appropriate corrective action. Corrective action may include the following:

- Reanalyzing samples if holding time criteria permit
- Resampling and analyzing the samples
- Evaluating and amending sampling and analytical procedures
- Accepting data and acknowledging a level of uncertainty

13.2 FIELD CORRECTIVE ACTION

During field investigations, any problem that affects samples received or monitoring data is documented and recorded in the field logbook by the person identifying the problem. A serious problem that affects overall project objectives is brought to the attention of the PRC project manager, who completes a corrective action request form (Figure 13-1) and immediately notifies the PRC TES 12 quality assurance manager. The TES 12 quality assurance manager and the project manager or their designees are responsible for identifying the causes of the problem and developing solutions.

FIGURE 13-1
Corrective Action Request Form

PRC Environmental Management, Inc.

Corrective Action Request Form QA/QC Level _____

Project/Contract No.: _____

Work Assignment Number: _____

Site Location: _____

Firm: _____

To (Work Assignment Manager): _____

From (Reviewer): _____
Signature

Date _____

Description of Problem: _____

_____

_____

_____

_____

Corrective Action Requested: _____

_____

_____

_____

_____

The above corrective action must be completed by: _____
(Date)

Corrective Action Taken: _____

_____

_____

_____

FIGURE 13-1 (continued)

QA/QC Level _____

Work Assignment Manager

(Subcontractor QA Manager)

Acknowledgement of Receipt

_____
(Initial/Date)

Correction Action Completed

_____
(Initial/Date)

Reviewer

Corrective Action is/is not satisfactory

_____
(Initial/Date)

Remarks

_____
_____
_____
_____

QA/QC Coordinators:

Corrective Action is/is not satisfactory

_____
(Initial/Date)

Remarks

_____
_____
_____
_____

Distribution: 1) Original to project file 2) Copy to QA/QC file 3) Copy to reviewer

14.0 QUALITY ASSURANCE REPORTS

Effective management of environmental measurements requires timely assessment and review of activities, which entails interaction among PRC personnel collecting the data, the PRC project manager, the PRC regional manager, the PRC TES 12 quality assurance manager, and EPA personnel. Written reports of field activities may be necessary to provide an ongoing evaluation of measurement data quality. These reports, produced on an as-required basis, may include the following:

- QA/QC audit results and other inspection reports
- Summary of corrective action activities, including any unresolved problems or past-due corrective actions
- Summary of unscheduled equipment maintenance activities
- Summary of any QAPjP changes
- Summary of project QA/QC activities and status

Reports of this type are be distributed to the PRC project manager, PRC regional manager, PRC TES 12 quality assurance manager, and EPA work assignment manager.

Routine QA/QC reports for TES 12 are prepared by the PRC regional manager and submitted to the PRC TES 12 quality assurance manager (PRC, 1988). If significant QA/QC activities concerning the YARL O&M inspection appear in this program QA/QC report, these activities also will be described in the monthly progress report for the YARL O&M inspection project.

If appropriate, PRC will submit a report at the completion of the field work containing a separate QA/QC section summarizing data quality and identifying any significant QA/QC activities that occurred during the investigation.

15.0 REFERENCES

Biospherics, 1988. Preliminary Soil and Ground Water Investigation of the United States Department of Agriculture Research Laboratory in Yakima, Washington. December 23, 1988.

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APPENDIX A

OPERATORS MANUAL FOR THE

HNu PHOTOIONIZATION DETECTOR

MODEL P-101

OPERATIONAL PROCEDURE FOR

HNu MODEL PI 101

PHOTOIONIZATION ANALYZER

PREPARED BY

CHENG-WEN TSAI, CHEMIST

QUALITY ASSURANCE OFFICE
U.S.EPA, REGION V

TABLE OF CONTENT

OPERATION PROCEDURE FOR
HNu MODEL PI 101
PHOTOIONIZATION ANALYZER

I. INTRODUCTION

1.0 Operation Principle

The HNu Model 101 photoionization detector has been designed to measure the concentration of trace gases in many industrial or plant atmospheres. The instrument has similar capabilities outdoors. The analyzer employs the principle of photoionization for detection. This process is termed photoionization because the absorption of ultraviolet light (a photon) by a molecule leads to ionization via:

$$RH + h\nu \longrightarrow RH^+ + e^-$$

where RH = trace gas
$h\nu$ = a photon with an energy greater than or equal to an ionization potential of RH.

The sensor consists of a sealed ultraviolet light source that emits photons which are energetic enough to ionize many trace species (particularly organics), but do not ionize the major components of air such as O_2, N_2, CO, CO_2 or H_2O. A chamber adjacent to the ultraviolet light source contains a pair of electrodes. When a positive potential is applied to one electrode, the field created drives any ions, formed by abosrption of UV light, to the collector electrode where the current (proportional to concentration) is measured. The useful range of the instrument is from a fraction of a ppm to about 2,000 ppm.

2.0 Instrument Sensitivity and Calibration

The instrument responds to atmospheric compounds with ionization potentials equal to or less than the ionization energy of the UV light source. If a compound in air has an ionization potential greater than the energy source of the lamp, it will not be detected. Table 1 presents organic and inorganic compounds and the light sources that should be used to detect each compound. The instrument is capable of using 1 of the 3 light sources - 9.5, 10.2, and 11.7 ev lamps. In addition, not all compounds respond equally to each light sources and thus they vary in their sensitivity to ionization. As a result of varying sensitivities to photoionization, the response given by the instrument may or may not reflect the actual atmospheric concentration of the compound being detected. Table 2 represents the relative sensitivities for various gases relative to a 10.2 ev light source. Use this table to determine the approximate response of the instrument to a compound of interest, and to select the appropriate light (lamp) source.

TABLE 1 LAMP SOURCE IONIZATION POTENTIALS
FOR ORGANIC AND INORGANIC AIRBORNE COMPOUNDS

9.5 eV Lamp Source

Acids (organic)
Alcohols
Amines
Aniline
Aromatics
Benzene
Borontribromide
Chlorinated aromatics
Dimethyldisulfide
Dimethylsulfide
Ketones
Phenol
Pyridine
Styrene
Toluene

10.2 eV Lamp Source

Acetaldehyde
Acetic acid
Acetone
Acids (organic)
Acrolein (acelyates)
Alcohols
Aldehydes
Aliphatics
Alkyl Halides
Allyl alcohol
Amides
Amines
Ammonia
Aniline
Aromatics
Arsine
Asphalt emissions
Benzene
Bromine
Butane
Boron tribromide
Carbon disulfide
Chlorinated aromatics
Chlorinated hydrocarbons
Chloropenes
Cyclohexanane
Dibromochloropropene
Dichloropropylene
Dimethyl disulfide
Dimethyl formal dehyde
Dimethyl sulfide
Epichlorhydrin
Esters
Ethanol
Ethyl methacrylate
Ethylene
Ethylene dibromide
Ethylene imine
Ethylene oxide
Furan
Heterocyclics
Hexane
Hexamethyl phosphoric triamide
Hydrazine
Hydrogen sulfide
Hydrogen selenide

TABLE 1 (CONTINUED)

10.2 eV Lamp Source (Cont'd.)

Iodine vapor
Isopropanol
Ketones
Lutidines
Methyl bromide
Methyl isocyanate
Methyl mercaptan
Methyl methacrylate
Mineral spirits
Naptha
Nitrates
Nitrites
Nitro alkanes
Nitro benzene
N-Octane
Olefins
Phenol
Phostoxin
Phosphine
Phosphorus trichloride
Picolines
Pinene
Propylene
Pyridine
Pyrole
Styrene
Tetrahydrofuran
Tetraethyl lead
Thionyl chloride
Toluene
Vinyl acetate
Vinyl bromide
Vinyl chloride
Vinylidine chloride

11.7 Lamp Source

Acetic anhydride
Acetylene
Acrylonitrile
Alcohols
Aldehydes
Alphatics
Alkyl halides
Butane
Carbon tetrachloride
Chloroform
Ethane
Ethylene dichloride
Formaldehyde
Formic acid
Methanol
Methylene chloride
Nitrates
Nitrites
Nitro alkanes
Phostoxin
Propane
Serafume

TABLE 2 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp)

Species	Photoionization Sensitivity
p-xylene	11.4
m-xylene	11.2
benzene	10.0 (reference standard)
toluene	10.0
dietnyl sulfide	10.0
diethyl amine	9.9
styrene	9.7
trichloroethylene	8.9
carbon disulfide	7.1
isobutylene	7.0
acetone	6.3
tetrahydrofuran	6.0
methyl ethyl ketone	5.7
methyl isobutyl ketone	5.7
cyclohexanone	5.1
naptha (85% aromatics)	5.0
vinyl chloride	5.0
methyl isocyanate	4.5
iodine	4.5
methyl mercaptan	4.3
dimetnyl sulfide	4.3
allyl alcohol	4.2
propylene	4.0
mineral spirits	4.0
2,3-dichloropropene	4.0
cyclohexene	3.4
crotonaldehyde	3.1
acrolein	3.1
pyridine	3.0
hydrogen sulfide	2.8
ethylene dibromide	2.7
n-octane	2.5
acetaldehyde oxime	2.3
hexane	2.2
phosphine	2.0
heptane	1.7
allyl chloride (3-chloropropene)	1.5
ethylene	1.0
ethylene oxide	1.0
acetic anhydride	1.0
a-pinene	0.7
dibromochloropropane	0.7
epichlorohydrin	0.7
nitric oxide	0.6

TABLE 2 RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp) (Continued)

Species	Photoionization Sensitivity*
b-pinene	0.5
citral	0.5
ammonia	0.3
acetic acid	0.1
nitrogen dioxide	0.02
methane	0.0
acetylene	0.0

*Expressed in ppm (v/v).

There are two types of operations that are used for calibration. For Type 1 Operation, a non-regulatory (or non-target) compound such as isobutylene is used for calibration. In this case, the instrument reading is reported in terms relative to the calibration compound used for calibration. For the type 2 operation, the target compound or compounds are used for calibration. As a result, the instrument is calibrated to respond directly in ppm by volume of the target compound(s).

3.0 Instrument Specifications

3.1 Performance

- Range : 0.1 to 2000 ppm
- Detection Limit : 0.1 ppm
- Sensitivity (max.) : 0 to 2 ppm FSD over 100 division meter scale
- Repeatability : ± 1% of FSD
- Linear Range : 0.1 to 600 ppm
- Useful Range : 0.1 to 2000 ppm
- Response Time : less than 3 seconds to reach 90% full scale
- Ambient humidity : up to 95% relative humidity
- Operating Temperature : Ambient to 40°C (instrument is temperature compensated so that a 20°C change in temperature corresponds to a change in reading of ± 2% full scale at maximum sensitivity.

3.2 Power Requirements and Operating Times

- Continuous use on battery : approximately 10 hours
- Continuous use with HNu recorder reduces instrument battery operating time to approximately 5 hours
- Recharge time : less than 14 hours; a 3 hours charge will charge up to 90% full charge
- Recharge Current : maximum 0.4 amps at 15 VDC

II. OPERATIONAL PROCEDURE

1.0 Instrument Check-Out

1.1 Remove instrument box cover by pulling up on fasteners.

1.2 On the instrument panel, there will be a label containing information on light source, calibration date, calibration gas, and span setting.

1.2.1 If the instrument has not been calibrated in the last 14 days or since its last field use, it should be recalibrated. Check the instrument log, which should be maintained with the instrument, for the instrument status and its calibration history. For general use, the instrument should be calibrated to isobutylene at a span setting of 9.8.

1.2.2 Check the label for light source and refer to Table 1 for ionization potentials of various compounds. If the compound you wish to detect is not listed for the light sources provided with instrument, then the light source will have to be changed. Use the probe with the proper light source for the compounds to be detected.

1.2.3 Once it has been determined that the instrument has the correct lamp, the instrument may need to be recalibrated for the specific compound of interest. Use Procedure under 2.I.3 of this Section to calibrate the instrument.

1.2.4 Check the battery supply by connecting the probe to the instrument box, and turning the function switch to the battery check position (Figure 1). (Note: The battery check indicator will not function unless the probe is attached.) The meter needle should deflect to the far right or above the green zone. If the needle is below or just within the green zone or the red LED indicator is on, the battery should be recharged. Follow the procedure described in Section III (Maintenance and Trouble shooting) to recharge the battery.

1.2.5 Repack the instrument for shipment to the field.

2.0 Field Operation

2.1 Calibration

2.1.1 Equipment and Materials

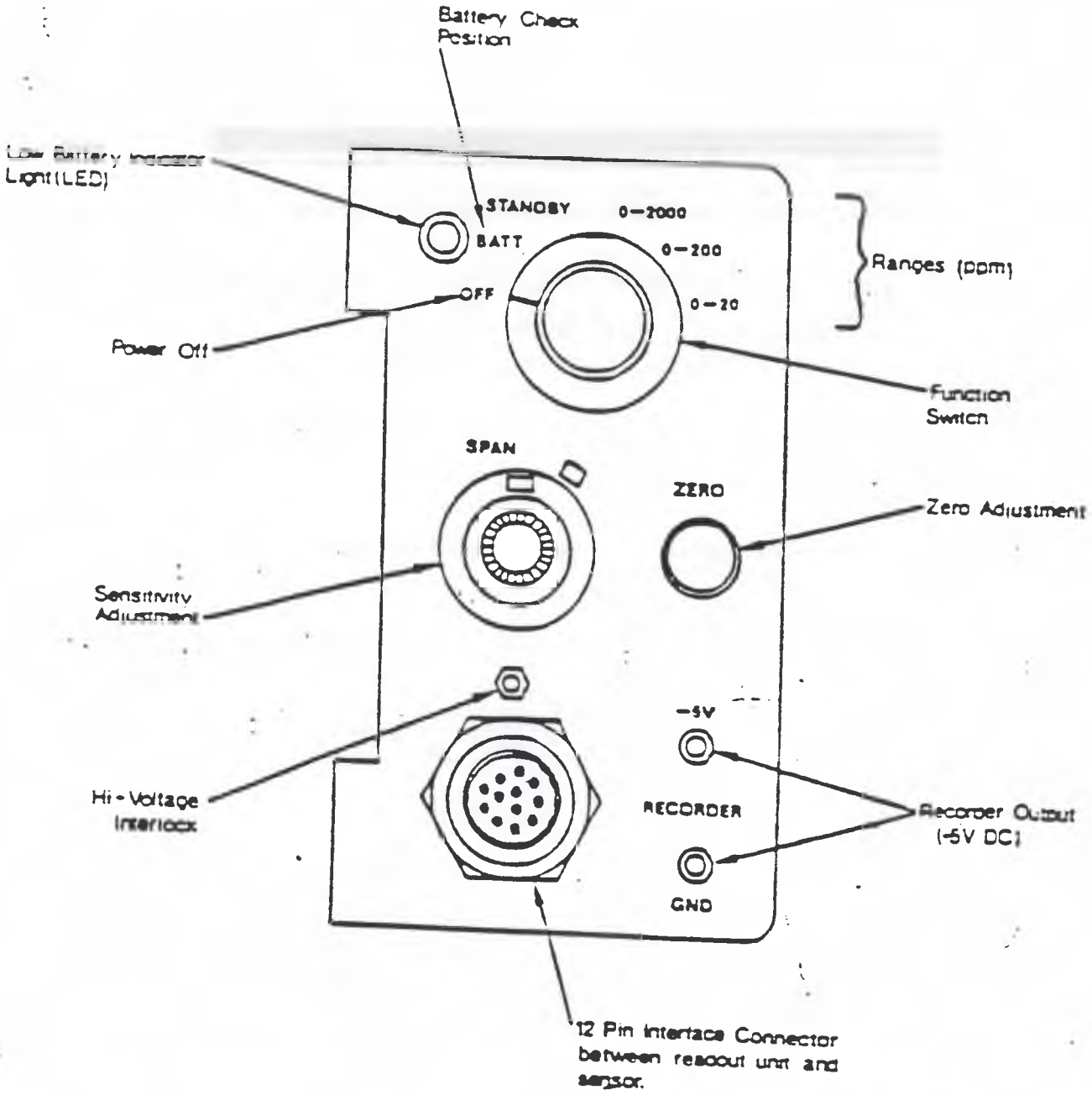


FIGURE 1 INSTRUMENT CONTROL PANEL FEATURES

0 Calibration Gas (2 ranges)

Low range 0-20 ppm and mid-range 20-200 ppm of isobutylene gas are used for standard field operation when contaminants are unknown or a mixture of gases is present. The isobutylene gas is used for general calibration because of the instrument's relatively high sensitivity to it and the non-toxic nature of the gas.
Note: A specialty gas may be required if a single atmospheric contaminant is present and the contaminant has a sensitivity different from that of the calibration gas (isobutylene).

0 Tubing and fittings (see Figure 2).

0 Rotometer or bubble flow meter.

0 Field Log, calibration form, and data reporting form.

0 Table 1 for ionization potentials for compounds of interest.

2.1.2 Calibration Frequency

This instrument should be calibrated after each field use and prior to each field use. Continuous calibration check should be performed frequently during field operation (for example, check the instrument zero and calibration after every 10 measurements) and document the results properly. Caution: Do Not Change the Settings.

2.1.3 Calibration Procedure

2.1.3.1 Use a three-points procedure to facilitate the proper instrument calibration over appropriate operating ranges. Distinct mixtures of calibration gas with known concentration for selective operating range should be used for calibration. Each mixture should give a 3/4 scale deflection in its respective operating range.

2.1.3.2 Instrument Setup.

Step 1: Remove Instrument cover by pulling up on the side straps.

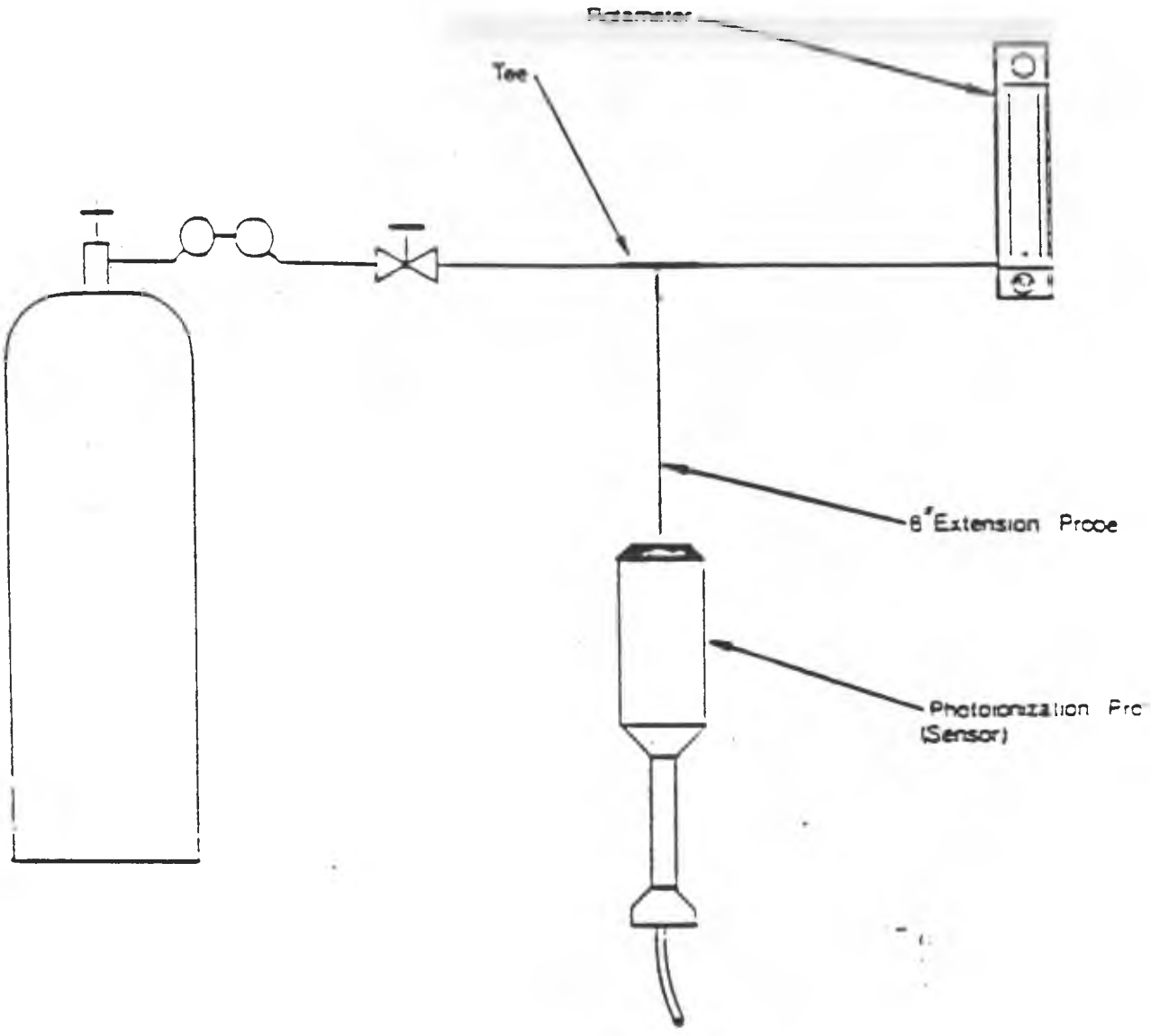


FIGURE 2 RECOMMENDED CALIBRATION PROCEDURE FOR PHOTOIONIZATION ANALYZER

Step 2: Prior to calibration, check the function switch (Figure 1) on the control panel to make sure it is in the OFF position. The probe nozzle is stored inside the instrument cover. Remove cover plate by pulling up on the pins that fasten the cover plate.

Step 3: Remove the nozzle from the cover. Assemble probe by screwing nozzle into casing.

Step 4: Attach probe cable to instrument box inserting 12 pin interface connector of the probe cable into the connector on the instrument panel. Match the alignment keys and insert connector. Turn connector in clockwise direction until a distinct snap and lock is felt.

Step 5: Turn the function switch to the Battery Check position. When the battery is charged, the needle should read within or above the green battery arc on the scale plate. If the needle is below the green arc or the red LED light comes on, the instrument should be recharged prior to making any measurements. Implement steps in Section III to recharge battery.

Step 6: Turn the function switch to the ON position. In this position, the UV light source should be on. To verify, gaze at the end of the probe for a purple glow. Do Not Look Directly at the Lamp Itself. If the lamp does not come on refer to Maintenance Step in 2.2 (Section III).

Step 7: To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counter clockwise rotation yields a downscale deflection. (Note: No zero gas is needed since this is an electronic zero adjustment.) If the span adjustment is changed during instrument calibration, the zero should be rechecked and adjusted. If necessary, wait 15 to 20 seconds to ensure that the zero reading is stable. Readjust as necessary.

2.1.3.3 Calibration Steps

Step 1: Insert one end of T tube (Figure 2) into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotometer (bubble meter) attached.

Step 2: Set the function switch in the 0-200 ppm range. Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotometer. The instrument will draw in the volume required for detection with the rotometer indicating excess flow.

Step 3: Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder).

Step 4: Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary following step 7 of 2.1.3.2.

Step 5: Record on form and field log all original and readjusted settings as specified in the form.

Step 6: Next, set the function switch to the 0-20 ppm. Remove the mid-range (20-200 ppm) calibration gas cylinder and attach the low range--(0-20 ppm) calibration gas cylinder as described above.

Step 7: Do not adjust the span potentiometer. The observed reading should be +3 ppm of the concentration specified for the low range calibration gas. If this is not the case, recalibrate the mid range scale repeating Step 1 thru 6 above. If the low range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. Clean window following Step 2 under 2.3 (Section III). When the observed reading is within the required tolerances, the instrument is fully calibrated.

2.2 Sample Measurement

Step 1: Place function switch in 0-20 ppm range for field monitoring. This will allow for the most sensitive, quick response in detecting airborne contaminants.

Step 2: Before entering a contaminanted area, determine background concentration. This concentration should be used as a reference to readings made in the contaminated area. Under no circumstance should one attempt to adjust the zero or span adjustments while the instrument is being operated in the field.

Step 3: Take measurements in contaminated area, recording readings and locations. Should readings exceed the 0-20 scale, switch the function switch to the 0-200 or 0-2,000 range as appropriate to receive a direct reading. Return the instrument switch to the 0-20 range when readings are reduced to that level. Record measuremeasurements in notebook or on an appropriate form.

Step 4: Keep in mind health and safety action guidelines for the level of protection you are wearing. Sustained readings above a certain level may force you to vacate an area or upgrade your level of protection.

Note: The instrument will not function properly in high humidity or when the window to the light housing is dirty. If the instrument response is erratic or lower than expected.

Step 5: When finished, use the reverse Steps 1 thru 5 of Section 2.1.3.2 (Instrument Setup) to shut down the instrument.

III MAINTENANCE AND TROUBLE-SHOOTING

1.0 Battery Recharging

1.1 The instrument should be recharged 1 hour for each hour of use or overnight for a full day's use. (The battery will last 10 hours on a full charge.)

1.2 To recharge the battery (or instrument):

1.2.1 Turn the function switch to the off position.

1.2.2 Remove the charger from the instrument top compartment.

1.2.3 Place the charger plug into the jack on the left side of the instrument box.

1.2.4 Connect the charger unit to a 120 V AC supply.

1.2.5 Check charger function by turning the instrument switch to the battery check position. The meter should go upscale if the charger is working and is correctly inserted into the jack.

1.2.6 Place instrument in instrument mode and charge for the appropriate time period.

1.2.7 Turn the instrument off following the recharge cycle. When disconnecting charger, remove from 120 V AC supply before removing the mini phone plug.

2.0 General Fault Determination and Correction

2.1 Battery level is low. Recharge if necessary implementing steps described under 1.0 (Section III). If the battery will not recharge, it will have to be replaced.

2.2 UV Lamp function - Gaze at sample inlet when mode switch is on an instrument function position and observe for purple glow of lamp. If the lamp does not glow in any of the three instrument function positions, it may be burned out and will have to be replaced. To replace the lamp:

1. Turn the function switch to the off position and disconnect the probe connector from the readout unit.

2. Remove the exhaust screw found near the base of the probe (Figure 3).

3. Grasp the end cap in one hand and the probe shell in the other and gently pull to separate the end cap and lamp housing from the shell.

4. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber does not fall out of the end cap and the lamp does not slide out of the lamp housing.

5. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out of it.

6. Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing.

7. Replace lamp with one of same energy source as the one removed by sliding it into the housing. Note: The amplifier board and instrument circuitry are calibrated for one light energy

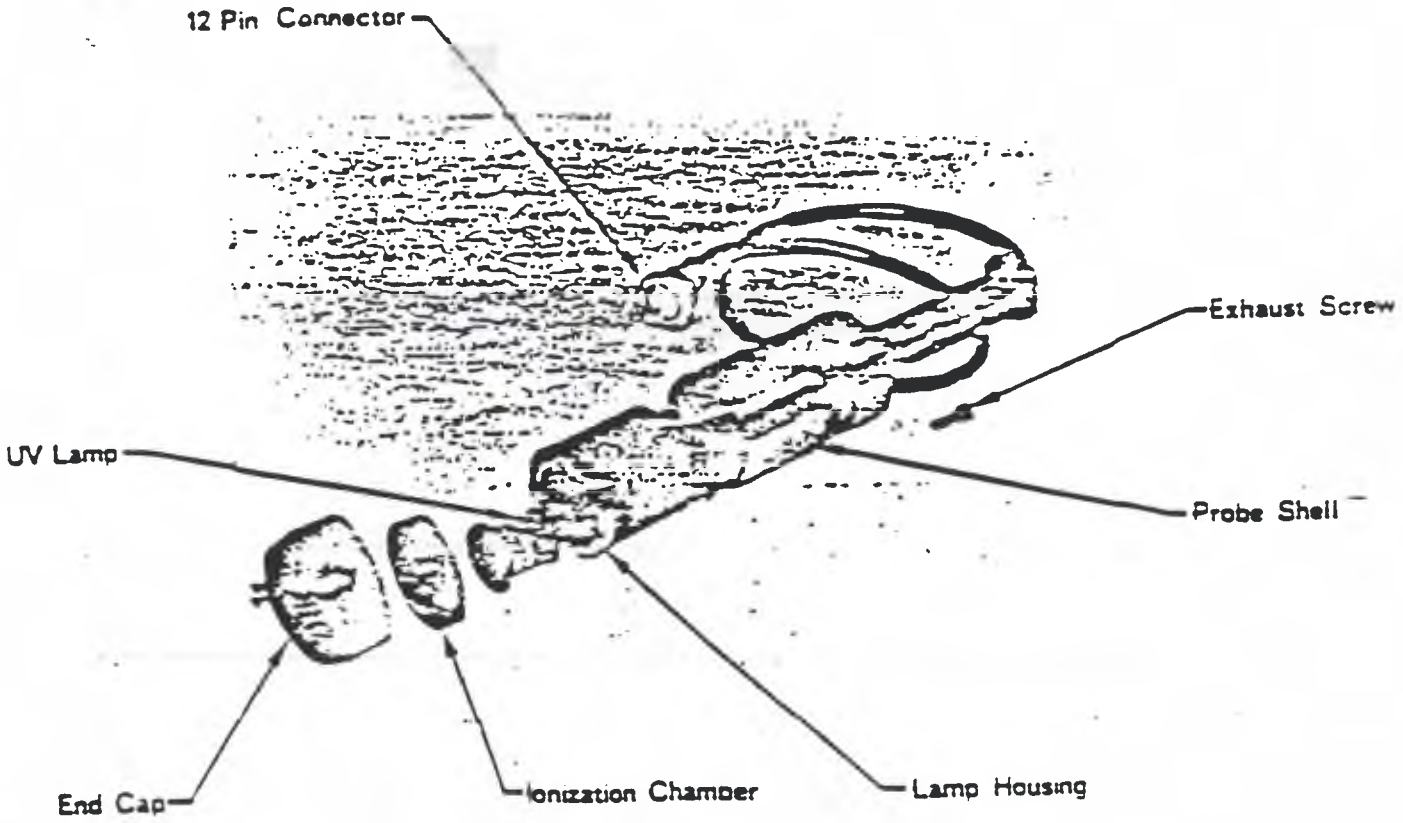


FIGURE 3 COMPONENT PARTS OF PROBE

8. Place the ion chamber on top of the lamp housing, checking to ensure that the contacts are aligned.

9. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the "O" ring. Do not overtighten.

10. Line up the pins on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. Do not force the assembly as it only fits one way.

11. Replace and tighten the exhaust screw.

12. Reconnect the 12 pin connector and turn instrument mode switch to a function position. Check for glow of lamp. If lamp still does not function, the instrument has an electrical short or other problem that will have to be corrected at the factory.

2.3 Instrument appears to be functional, but responses are lower than expected or erratic. The window of the light source may be dirty and need to be cleaned. To clean the light source window:

1. Disassemble the probe assembly by repeating Steps 1 thru 6 under 2.2 above.

2. Clean the window of the light source using compound provided with instrument and soft clean cloth. Important: Use cleaning compound on the window of the 10.2 eV lamp only. The cleaning compound may damage the windows of the 9.5 and 11.7 eV lamps.

3. Reassemble the probe assembly repeating Step 7 through 12 above.

3.0 Specific Faults

3.1 No meter response in any switch position (including BATT CHK)

1. Broken meter movement: Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.

2. Electrical connection to meter is broken: Check all wires leading to meter and clean the contacts of quick-disconnects.

3. Battery is completely dead: Disconnect battery and check voltage with a volt-ohm meter.

4. Check 2 amp fuse.

5. If none of the above solves the problem, consult the factory.

3.2 Meter responds in BATT CHK position, but reads zero or near zero for all others.

1. Power supply defective: Check power supply voltages per Figure 4. If any voltage is out of specification, consult the factory.

2. Input transistor or amplifier has failed: Rotate zero control; meter should deflect up/down as control is turned. Open probe; both transistors should be fully seated in sockets.

3. Input signal connection broken in probe or readout: Check input connector on printed circuit board. Should be firmly pressed down. Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object. Check all wires in readout for solid connections.

3.3 Instrument responds correctly in BATT CHK, and STBY, but not in measuring mode.

1. Check to see the light source is on (See Section 2.2).

2. Check high voltage power supply (See Figure 4).

3. Open end of probe, remove lamp and check high voltage on lamp contact ring.

4. If high voltage is present at all above points, light source has most likely failed. Consult the factory.

3.4 Instrument responds correctly in all positions, but signal is lower than expected.

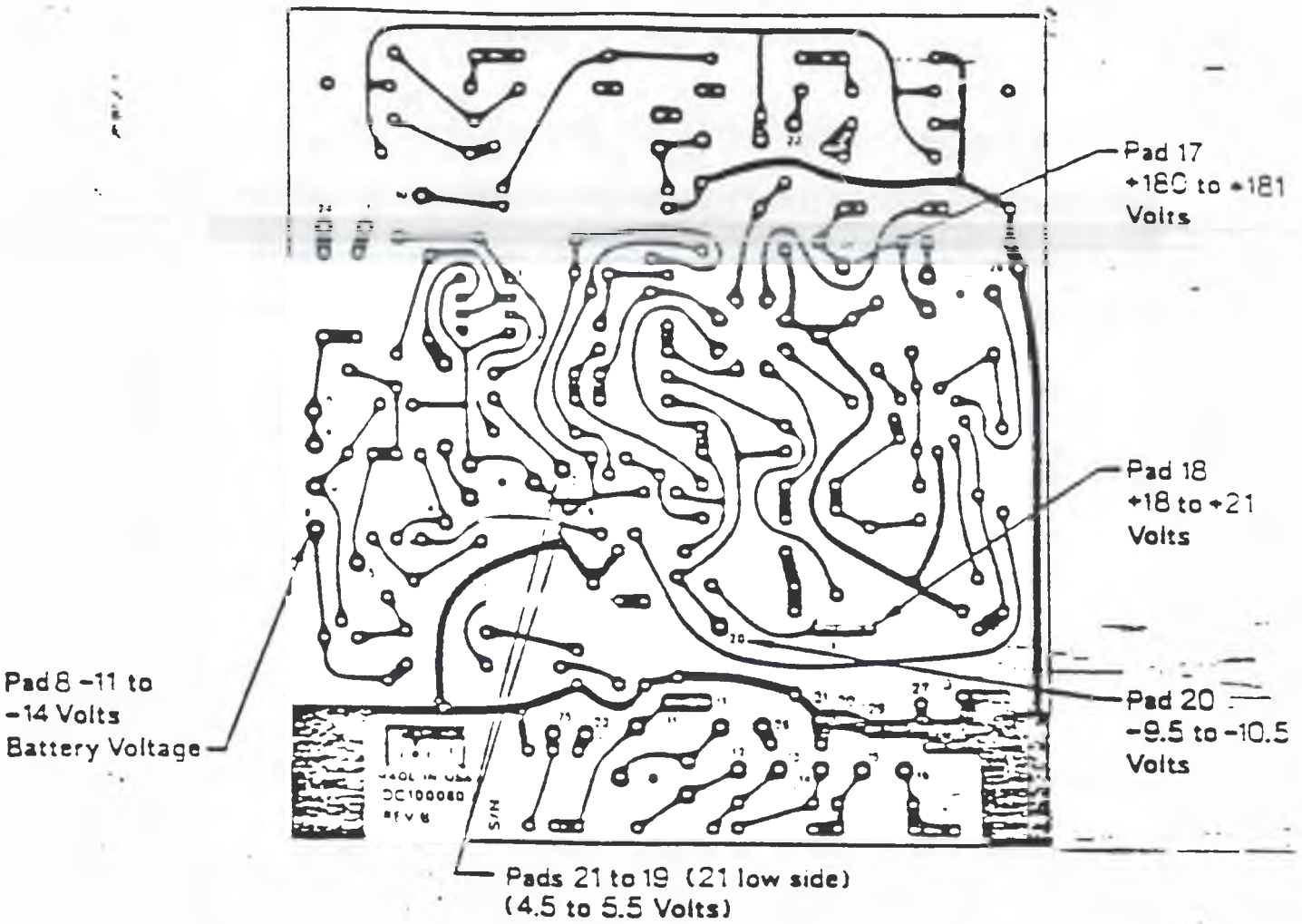
1. Check span setting for correct value.

2. Clean window of light source (See 2.3).

3. Double check preparation of standards.

4. Check power supply 180 V output. See Figure 4.

5. Check for proper fan operation. Check fan voltage. See Figure 4.



All Voltages Respect to Ground							
pads	voltage	pads	voltage	pads	voltage	pads	voltage
1	— 5.7V	9	— 12.2V	17	180V	25	0
2	GRD	10	— 12.1V	18	+ 19.4V	26	0
3	GRD	11	0	19	— 10.6V	27	GRD
4	—10.7V	12	0	20	— 9.7V	28	0
5	— 11.3V	13	0	21	— 14.5V	29	GRD
6	— 12.1V	14	0	22	—400V	30	GRD
7	0	15	0	23	0	31	GRD
8	— 12.2V	16	0	24	0		

Figure 4 Power Supply PC Board

6. Rotate span setting. Response should change if span pot is working properly.

3.5 Instrument responds in all switch positions, but is noisy (erratic meter movement).

1. Open circuit in feedback circuit. Consult the factory.

2. Open circuit in cable shield or probe shield. Consult the factory.

3.6 Instrument response is slow and/or irreproducible.

1. Fan operating improperly. Check fan voltage. See Figure 4.

2. Check calibration and operation.

3.7 Low battery indicator.

1. Indicator comes on if battery charge is low.

2. Indicator also comes on if ionization voltage is too high.

Planning Research Corporation

PRC EMI Staff

August 15, 1988

Elsa Krauss

Questions Concerning the HNU PI 101

Below are the questions and answers regarding the HNU PI 101 that were brought up during the lunch seminar on August 2nd.

I talked to Tara Velasco (Technical Specialist), Maureen Riley (Service Department Supervisor) and Bob Purdy (National Service Manager) from HNU Systems Inc. Each answer indicates the person whom I talked to.

1. Question: Moisture seems to be a problem. The needle deflects negative.

Answer: Water vapor may collect in the ionization chamber and affect instrument sensitivity. Tara Velasco recommends allowing the instrument to equilibrate for at least one hour in the environment in which it will be used. Also, a single layer of cheese cloth may be placed over the probe inlet (or over the probe extension) to absorb water vapor and filter out dust particles before they enter the detector. This practice does not solve the contamination problems, it only minimizes them. The practice is acceptable as long as the flow of sample through the probe is not restricted.

Tara recommends cleaning the lamp and ion chamber daily (depending on use)** In addition to cleaning the lamp and ion chamber, Maureen Riley recommends cleaning the probe extention by flushing it with acetone or methanol to remove contaminats that could be drawn into the probe and detected. All parts must be completely dry before reassembly.

2. Question: Instruments are not holding "the calibration" after they come back from service at HNU Systems Inc.. This is indicated by the need to turn the span pot knob to lower numbers and it happens whithin two or three days of service.

Answer: Maureen indicated that this is a sign of a dirty lamp and ion chamber. She stated that the span setting of 9.8 is simply a reference point, and adjusting the span setting is not an indication of instrument malfuction. As the lamp gets dirty and/or ages, it loses sensitivity; therefore, it is necessary to increase the gain of the lamp by lowering the span setting.

If the lamp and ion chamber have been cleaned, and the lamp is good, there is an internal potentiometer (R48 on the power supply board) which can be adjusted to increase the gain of the lamp*. Adjustment on this internal pot should be done on rare occasions as it is delicate.

If all the above is performed and a good calibration and sensitivity cannot be obtained, a new lamp is recommended.

3. Question: Batteries don't hold the 8 hour charge as indicated in the manual. They seem to hold an average of six hours (with the instrument running constantly or in stand by).

Answer: Maureen recommended checking the battery contacts (they may need cleaning). When not taking measurements, turn the instrument off; don't leave it on stand by unless another measurement will be taken in a few minutes.

The output of the charger is -15 VDC. This output can be adjusted to -16 VDC*, which may help lengthen the daily use of the battery. Batteries should be charged whenever the PI 101 is not in use. The probe should be attached to the readout module, and the unit function switch should be in the OFF position.

4. Question: CH2M Hill recently recommended the calibration to be performed by transfering the gas from the canister to a Tedlar bag, then calibrate the instrument with the gas from the bag.

Answer: Jim Beringer (CH2M Hill) indicated that by transfering the gas from the canister to a bag it will be at atmospheric presure and the instrument's fan will pull the gas as opposed to being introduced by presure.

Bob Purdy indicated that it is a technique which is sometimes recommended, particularly for certain special applications. However, use of the canister is also good, and HNU does not intend to replace the canister method with use of the Tedlar bag.

* These functions should be performed by an HNU trained and certified person (such as Elsa Krauss)

** The PID responds to water with a negative singal. Presence of higher than normal amounts of water in the atmosphere (90% relative humidity) may result in inaccurate sample readings. The presence of the water means more frequent cleaning of the ion chamber may be needed to remove the water and water absorbing contaminants.

I hope that this discussion has cleared some of the concerns. If you still have some questions or more problems arrive, please do not hesitate to let me know.

cc: T. Velasco, HNU Systems
M. Riley, HNU Systems
B. Purdy, HNU Sytems
C. Berney, HNU Systems